LINKING INSTITUTIONAL CHARACTERISTICS TO COMMUNAL NATURAL RESOURCE CONSERVATION IN CUMBRES DE MONTERREY NATIONAL PARK

A Dissertation

by

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ABSTRACT

National parks in developing countries often have inhabitants that practice communal land management. Potential drivers for sustainable communal land management have been identified in literature, however these drivers appear to vary from case to case and their validity remains to be further tested. The objectives of this research are to understand the factors that promote and deter; park promoted conservation, overharvesting, overgrazing, and trust in members to follow the rules.

This study focuses on *Cumbres de Monterrey* National Park in Mexico. Household surveys were conducted amongst 14 communities that reside in or have boarders with the National Park. Using survey data, logistic regressions were performed to identify the influencing factors of perceived overharvesting, overgrazing, park promoted conservation, and trust in members to follow the rules. Overgrazing rules were perceived to be just and external government punishment was associated with reduced perceptions in overgrazing. Overharvesting rules were not perceived to be just and external government punishment was associated with perceptions of overharvesting. As a result, rules that are not perceived as just can result in possible retaliation harvesting. *Comunidades* were more likely to report overgrazing than *ejidos.* Current compensation for labor in the park is affiliated with reduced perceptions of park promoted conservation. A local compensation program from water fees that is voluntary and has land owner involvement in encouraged. Recipients of government assistance are more likely to report there is overgrazing. There are decreasing levels of trust of

members to follow the rules when rule breakers are punished, sustainable harvest allowances are encouraged.

DEDICATION

In loving memory of my "Papaw" Dr. OB Clifton, who dedicated his career life to Texas Agriculture Extension and assisting small farmers. He was responsible for overseeing the integration of the prior racially segregated extension systems. May his dedication to civil rights, helping others, and academic excellence inspire us all.

To my parents, Guy and Karen Clifton, who have always believed in me and worked hard to provide the best education possible at all times.

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NOMENCLATURE

SEMERNAT	Secretary of the Environment and Natural Resources *Secretaría de Medio Ambiente y Recursos Naturales*
PROCEDE	National Certification Program of *Ejido* Rights and Urban Lots *Programa Nacional de Certificación de Derechos Ejidales y Titulación de Solares Urbanos,*
UNESCO	United Nations Educational, Scientific, and Cultural Organization
CNANP	National Commission of Protected Natural Areas *Comisión Nacional de Áreas Naturales Protegidas*
SAGARPA	Secretary of Agriculture, Livestock, Rural Development, Fisheries, and Feed *Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca, y Alimentación*
SEDESOL	Secretary of Social Development *Secretaría de Desarrollo Social*.
IUCN	International Union for the Conservation of Nature
CONABIO	National Commission for the Knowledge and Use of Biodiversity *Comisión Nacional para el Conocimiento y Uso de la Biodiversidad*
VIF	Variance Inflation Factor

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CHAPTER I

INTRODUCTION

1.1 Problem Statement

Conversation promotion through the establishment of national parks is a means to preserve nature and ecosystem services that are vital for humans. The establishment of National Parks is quite new, over half of the National Parks were created in the last fifty years (Dudley *et al.*, 2011). The growth of protected areas, particularly in developing countries has grown exponentially over the past 25 years. The mission of protected areas in developing countries has shifted from focusing solely on conservation to that of including aspects for improving human welfare. This has resulted in a shift in favor to allow local resource use (Naughton-Treves *et al.*, 2005). The International Union for the Conservation of Nature (IUCN) has classified protected areas into six categories that range from areas that strictly limit human activity to those that allow for sustainable use (IUCN, 2013). Human population growth on the borders of protected areas in Latin America and Africa is double the average of rural population growth rates and it positively correlated with funding (Wittemyer *et al.*, 2008). The establishment of the first parks in Mexico created land tenure conflicts. President Lazaro Cárdenas recommended that the establishment of parks should guarantee communal land tenure (Velázquez, 2012). Communal land management is not only common in many parks in Mexico but also globally, where an estimated two billion people maintain their subsistence based livelihoods (ILC, 2007). Communal systems have often been characterized for overexploitation and degradation due to their open access nature

(Hardin, 1968). However, successful communal land management has been proven with a defined group of users with self-governance. Proxy indicators for successful communal land management have been defined (Baland & Platteau, 1996; Wade, 1988 & 1994; Ostrom, 1990). Successful communal land management inside national parks is important since resettlement schemes only work when they are truly voluntary (Schmidt-Soltau & Brockington, 2007; Cernea & Schmidt-Soltau, 2006) and resettlement schemes are not always possible. Ecotourism, is not always profitable, or when it is, does not always derive income for all stakeholders (Tisdell, 1995). While successful proxy indicators for management and institutional success have been theoretically and qualitatively defined (Baland & Platteau, 1996; Wade, 1988 & 1994; Ostrom, 1990), the list of variables that are important by locality differ (Agrawal, 2001). Important differences exist among the types of collective-action problems that communities confront (Poteete & Ostrom, 2004). Thus, research is needed in conservation areas where communities reside, to determine which variables hold significant relationships, and to provide information for improved conservation and collective outcomes.

While there are various indicators for success, sustainability and excludability are common success proxies that are determined to be essential. Sustainability is often used as a rough index for management success. However, sustainability does not necessarily imply that resource utilization is optimal from either an ecological or economic standpoint (IUCN, 1980). Excludability reflects successful governance that prevents communities from becoming an open access system that can result in the tragedy of the commons (Feeny *et al.,* 1990). Although sustainability and excludability are essential

components for communal land management success, perceptions of conservation must also be taken into consideration when looking at successful communal land management in National Parks.

It is widely accepted that the long-term survival of protected areas in developing countries will be jeopardized if needs, aspirations, and attitudes of local people are not accounted for (Ghimire & Pimbert, 1997; Raval, 1994; Kemf, 1993, West & Brechin, 1991; McNeely, 1990; MacKinnon & MacKinnon 1986; Machlis & Tichnell, 1985). While many studies take into account conservation perceptions of park residents (Allendorf *et al.*, 2007; Ormsby & Kaplin, 2005; Conforti *et al.*, 2003; Marcus, 2001; Alexander, 2000; Natura, 1995; Ite, 1996), studies on conservation near parks often do not take into account governance, which could improve conservation outcomes (Balint, 2006). A gap exists in the literature where sustainability, excludability, and perceptions in conservation in national parks are studies in a holistic way. An examination of the links between sustainability, excludability, and perceptions in conservation can improve ecological outcomes by evaluating multiple factors that can influence communal land management success in and around national parks.

Good governance is linked to excludability, sustainability, and perceptions in conservation. Baland & Platteau (1996), Wade (1988 & 1994), and Ostrom (1990) were all referring to excludability in their seminal works of successful communal land management when they referred to clear boundaries, ease of enforcement, and locally devised access and management of rules. Excludability is an aspect of good governance that was deemed important for successful communal land management. A critical aspect

of sustainability is resilience. Interventions for resilience immediately confront governance. Resilience can be improved through increased participation and deliberation, polycentric and multilayered institutions, and accountable authorities that pursue just distribution of benefits and involuntary risks (Lebel *et al.*, 2006). In a study conducted by Balint (2006), conservation was deterred by a lack of local governance in one community and good local governance in another community resulted in park promoted conservation. In this study, indicators of governance are examined in relation to sustainability, perceptions in conservation, and excludability for communities that reside in and around *Cumbres de Monterrey* National Park in Northern Mexico.

Cumbres de Monterrey National Park is an important conservation area that provides 70% of the water for the city of Monterrey (the 3rd largest city in Mexico), is a habitat for many bird species, and the black bear (CONANP, 2013). The park has a history of tension from surrounding areas appealing for its conservation. The area was first declared a naturally protected area in 1939 by president Lázaro Cárdenas, after groups in the area asked for land concessions to maintain a hydrologic balance in the region. Federal law protected communal land endowments (*ejidos*) in National Parks from expulsion. Land pressures continued with the expansion of the nearby metropolitan area and President Manuel Ávila Camacho stated that urban expansion would be harmful and that lands should be utilized for agriculture for the good of the nation. Agricultural exploitation was not a view that was held by all actors in the area. A national study of the *Sierra Madre Oriental* was conducted in 1996, which led to the state of *Nuevo Leon* requesting that the natural area receive National Park status. The

area was declared a National Park in November 2000. Many communities that traditionally resided in this area relied on livestock grazing, subsistence agriculture, and intensive agriculture (CONANP, 2007). Since the formation of the park, trees and wild herbs are no longer able to be legally harvested, and animals must graze inside communal boundaries. A wood mill was closed in one community, and park officials are not welcomed there. The park agency and the Secretary of the Environment and Natural Resources (SEMERNAT) sanctioned bad natural resource use. Some communities also internally sanctioned members. Communities varied in their accessibility, with some near paved roads and many off dirt roads that can become impassible depending on the weather. Many of the park residents rely on agriculture for subsistence and received governmental assistance. Donkeys were a common mode of transit to pass through the steep slopes to get to the other side of a mountain or hillside. Sustainable management of pasture, forests, and rivers are important since the park lies in a watershed recharge zone.

1.2 Objectives

The overall goal of this dissertation was to understand how to promote conservation amongst park inhabitants in *Cumbres de Monterrey* National Park. This study sought to determine the variables that influence the conservation of natural resources in the communal lands within or surrounding the National Park. This study looked specifically at sustainability, excludability, and conservation promotion since they are important to further conservation outcomes. As good governance is interlinked with all of these factors, governance indicators from Baland & Platteau (1996), Wade

(1988 & 1994), and Ostrom (1990) were included to determine which variables have significant relationships since these factors may differ by locality (Agrawal, 2001). Proxy indicators were used for sustainability, excludability, and conservation perceptions. Sustainability here was measured using the indicators of overgrazing and overharvesting of natural resources other than pasture. Excludability was measured by trust in members to follow the rules. Perceptions in conservation were defined as adoption of park promoted conservation practices. This study sought to expand on communal success determinates by:

- understanding the factors that promote or deter park promoted conservation perceptions;
- understanding the factors that promote or deter overharvesting and overgrazing; and
- understanding the factors that promote or deter trust in members who follow the rules.
- understand if *comunidades* would have better resilience to respond to and prevent overgrazing
- understand whether communities in the *Cumbres de Monterrey* National Park reduce overgrazing with or without external government sanctioning.
- understand how the parks affects attitudes
- understanding the factors that are likely to contribute to overgrazing on the communal lands in and near the National Park.

Knowing which factors of governance are related to each of these success determinants is essential to inform conservation policy and management within the park. The long-term survival of protected areas in developing countries will be jeopardized if needs, aspirations, and attitudes of local people are not accounted for (Ghimire & Pimbert, 1997; Raval, 1994; Kemf, 1993; West & Brechin, 1991; McNeely, 1990; MacKinnon & MacKinnon, 1986; Machlis & Tichnell, 1985).

1.2.1 Main Contribution of this Research

The main contribution of this research is to show that rules that are not perceived as just do not work. Government punishment was associated with reduced overgrazing and increasing overharvesting. The majority of the respondents (88.9%) believed that overgrazing rules were just and only 37.6% of respondents believed that overharvesting rules are just. This study also compares *ejido* and *comunidad* management. This is important because 40% of Mexican agrarian land is under communal tenure (Wilson & Thompson, 1993). Ejidos in this study provide greater conservation benefits than *comunidades*. *Comunidad* members were more likely to state that there is overgrazing than *ejido* members. This study shows that further research is needed to understand if this is replicated at the national level. This could further demonstrate that well defined institutional structures provide greater benefit for conservation. This study also confirms previous tested relationships regarding successful communal land management. This study finds contradictory results to prior studies regarding community transparency, the frequency of communication, rule breakers punished, and rules being made by the community as promoted in prior literature.

CHAPTER II

LITERATURE REVIEW

To promote conservation in communal lands in *Cumbres de Monterrey* National Park it is important to understand factors that facilitate or hinder sustainability (defined here as overgrazing and overharvesting), excludability (defined here as trust in members to follow the rules), and perceptions in conservation (defined here as adaptation of park promoted conservation practices). Sustainability, excludability (Feeny *et al.,* 1990), and perceptions in conservation (Ghimire & Pimbert, 1997; Raval, 1994; Kemf, 1993; West & Brechin, 1991; McNeely, 1990; MacKinnon & MacKinnon, 1986; Machlis & Tichnell 1985) have all been determined to be essential for communal land management success and essential for the long term survival of protected areas. While there are multiple communal land management studies, it was important that conditions that facilitate and hinder collective action were identified (Poteete & Ostrom, 2004). Few studies of communal land management provide rigorous measures of independent variables that might affect sustainability and ecological success (Agrawal, 2002).

Governance is an essential component of sustainability, excludability (Feeny *et al.,* 1990), and conservation perceptions (Balint, 2006) and governance factors vary by locality (Agrawal, 2001). There are multiple studies have examined the conservation successes of *ejido* land in Mexico (Galletti, 1998; Porter-Bolland, 2012; Chowdhury, 2010; Gerritsen, 1998); however, factors that contribute to these successes vary, and local institutional variables are often ignored. Many case studies do vary and do not have broad applicability. However, there are "three comprehensive attempts to produce

theoretically informed generalizations about the conditions under which groups of self-organized users are successful in managing their common dilemmas," and are used for this study (Agrawal, 2002). These studies have been shown to be robust in a comparison with findings that a larger set of studies of the commons has identified (Agrawal, 2002). Thus the indicators presented Baland & Platteau (1996), Wade (1988 & 1994), and Ostrom (1990) were used as proxy indicators for governance success. The principles presented by each author differ and there is some overlap between the principles. Please see principles in Appendix A. It is important to note that both Ostrom (1990) and Baland & Platteau (1996) formed their variables based on a comprehensive and synthetic review of a large number of studies on the commons.

While much has been written about communal land management success, questions remain on the best way to promote conservation for communities in national parks. For example, how should stakeholders reduce overgrazing and overharvesting, and how do they improve rule compliance and excludability through increased trust in members to follow the established rules. Attitudes towards community-based conservation are likely to differ among people of different demographic and socio-economic class as they have differing needs and aspirations (Mehta & Kellert, 1998). Thus, the~~se~~ variables in Table 5, were explored in greater depth in this study to understand further how conservation and communal success can be promoted amongst communal lands (*ejidos* and *comunidades*) that reside inside or near *Cumbres de Monterry* National Park.

2.1 Park Conservation Perceptions by Inhabitants

Research on the attitudes of local residents toward protected areas has been conducted in various countries (Selebatso *et al.*, 2008; Bauer, 2003; Infield & Namara, 2001; Ite, 1996; Natura, 1995). External actors do not easily introduce conservation norms. It is not generally known which strategies successfully alter the norms people hold about conservation, particularly when they are a part of the family income (Agrawal & Gibson, 1999). There are different ways that the park promotes conservation; through trainings, rules, and compensation for labor. Trainings are given in the park by multiple actors but the park conducts trainings particularly on wild fire prevention. Rules in the park prevent users from cutting down live trees, collecting wild herbs, grazing outside of communal boundaries, having animals in the roadways, allowing animals to stay near streams or rivers, littering, and extracting soil or rocks. Compensation in the form of labor payment is given to a few people for planting trees, maintaining nurseries, and assisting with wildfires. There is one community were a few members receive federal payment not affiliated with the park for not cutting down fir and spruce trees on their individual parcels. Although there are many ways that the park promotes conservation only compensation, trainings, boundary clarity, type of resource user, and communication frequency about natural resource management are factors that influence conservation perceptions. Compensation can change conservation perceptions because negative attitudes are frequently associated with situations where the perceived costs to individuals and communities outweigh the perceived benefits (Frauman & Banks, 2011; Trakolis, 2001; Walpole & Goodwin, 2001). Compensation can change

negative attitudes by making the benefits greater than the costs. Attitudes have also been shown to be more positive toward conservation with an increase in income in Nepal (Mehta & Kellert,1998). Use of economic incentives is usually more successful than authoritarian regulation when it comes to enlisting local support for conservation programs (Coria & Calfucura, 2012; Infield & Namara, 2001). Conservation and monitoring of resources are difficult to achieve when boundaries are unclear (Wade, 1988 & 1994; Ostrom, 1990). Park conservation promotion attempts may have dismal results if boundaries are not clear. Different resources users and income groups have different tendencies to support conservation measures (Mheta and Kellert,1998; Natura, 1995). It was questionable how people that rotate their livestock for grazing would accept conservation promotion.

2.1.1 Independent Variables

Compensation

Compensation can change conservation perceptions because negative attitudes are frequently associated with situations where the perceived costs to individuals and communities outweigh the perceived benefits (Frauman & Banks, 2011; Trakolis, 2001; Walpole & Goodwin, 2001). When Bruner *et al.* (2001) looked at 93 protected areas in 22 countries they found that park effectiveness correlates with activities such as enforcement, boundary demarcation, and direct compensation to local communities. Pechac *et al.*(2013), in a review of literature on protected areas in developing countries found verifying the impact of compensation on achievement difficult to prove.

Trainings

Trainings are a common method for conservation promotion (Ebert, 2010; Pesek *et al.*, 2010; Cramb, 2006; Long *et al.*, 2003; Cramb and Culasero; 2003). For conservation trainings to be more effective, there needs to be a clear understanding of the desired outputs, outcomes, and impacts amongst all parties which can sometimes be lacking in conservation training (Fien *et al.*, 2001). However, conservation project perceptions can still be unfavorable if trainings do not result in improvements in the communities expressed priority needs(Mehta & Kellert, 1998).

Boundary Clarity

Wade (1988 & 1994) and Ostrom (1990) specified the importance boundary clarity for communal land management success. The authors believed that clear boundaries are necessary to exclude users to prevent it from becoming an open access system. Boundary clarity is also talked about in conservation literature; unclear boundaries are seen as a threat to conservation that can lead to conflict(Wunder *et al*, 2008; Yasmi *et al*, 2007; Mugisha *et al*, 2004). When boundaries are unclear and the resources in question have high economic value, land claims and conflicts intensify. Agreeing on a mutually accepted boundary becomes important (Wunder *et al*., 2008). Well defined boundaries reduce uncertainty about who will benefit and who will pay the costs. Poorly defined boundaries increase uncertainty and impede efforts for a collective solution (Gibson *et al.*, 2005; Dietz *et al.*, 2003). To understand this further Gibson *et al.* (2005) illustrates a possible scenario when boundaries are ill-defined. When few resources are allocated to monitoring or enforcement, illegal harvesters are able to

harvest from boundaries when they are ill-defined. If the illegal harvesters are caught, they can often offer a side payment to the monitor that is lower than the sanction. Poorly paid monitors have a difficult time refusing such offers. The boundary clarity that is looked at in *Cumbres de Monterrey* is the boundary between legitimate and nonusers of the resource and not the boundary of the resource system (Dietz *et al.*, 2003).

Pasture Rotation

Semi-nomadic and nomadic pastoralists are citied as having often times rich conservation knowledge (Stave *et al.*, 2007; Goldman, 2003; Fernandez-Gimenez, 2000). When Stave *et al.* (2007) compared the ecological knowledge of semi-nomadic to sedentary pastoralists, they found that semi-nomadic pastoralists had greater conservation knowledge. Pastoralist societies have developed adaptations for resilience over many generations. Adaptations can vary and from management of reserve pastures, reciprocity among herders, and a diversity of movement patterns (Niamir-Fuller, 1998, p. 250-284). Not all communal members in *Cumbres de Monterrey* National Park rotate their animals and those that do were considered a special group since they have potentially greater conservation knowledge. Different resources users and income groups have different tendencies to support conservation measures (Mehta & Kellert, 1998; Natura, 1995).

Communication Frequency about Natural Resource Management with Communal Members

As members communicate more often, they transfer conservation knowledge to others. Farmer field schools use a model of informal communication knowledge transfer

to try improve agricultural practices amongst small-scale farmers (Anandajayasekeram *et al.*, 2007; Feder *et al.*, 2004; Rola *et al*., 2002). Communication frequency about natural resource management might promote conservation practices and was included in this study to inquire about this possible relationship further. Increased communication frequency could influence how the park either promotes or discourages conservation practices by influencing trust and fairness perceptions, and knowledge transfer.

2.2 Overgrazing and Overharvesting

2.2.1 Overgrazing

Mexico is one of the countries that is most severely affected by desertification (Campbell & Berry, 1997). Desertification, resulting from over-cultivation and overgrazing is especially severe in the Northern Region of the country where rain-fed agriculture and livestock production are key economic drivers (Manzano *et al.*, 2000). SEMERNAT (2003) listed the main causes of land degradation and their contributing percentages as; overgrazing (39%), agriculture (39%), deforestation (16%), and urbanization (3.5%). Marginal lands are a characteristic of *ejidos* due to dry climate, poor soils, and severely degraded conditions (Ezcurra & Montaña, 1990; La Baurne and Dahl, 1986). Marginal lands are increasingly susceptible to overgrazing. Land degradation is linked to water shortages (Duda, 2003; Ripl, 2003). Little is known about what institutional characteristics lead to overgrazing in *ejidos* and *comunidades.* Overgrazing in Mexican *ejidos* has been characterized as a result of property management deterioration (Wilson & Thompson, 1993). According to the 2007 *Ejido* Census, 54.1% of the land in Mexico is covered by *ejido* or *communidad* tenure (INEGI,

2008). It is essential to understand the institutional characteristics that can lead to overgrazing to prevent further land degradation and subsequent water shortages. In this section, I review some important factors that were identified in the literature as contributors to overgrazing. Because of their relevance, these factors also are incorporated in my survey questions and modeling effort to test their association with perceived overharvesting of natural resources in the study area.

Government Assistance

The understanding of the processes and linkages between poverty, land degradation, and growth is extremely limited and largely driven by perceptions of those undertaking the analysis. A lack of data and the complexity of the relationships limit a deeper understanding of each (Malik, 1998). Households who do not practice sustainable systems will in the long term suffer increased poverty (Ellis-Jones, 1999). Overgrazing and land degradation is often associated with poverty, either because poor people live on marginal land (Dobie, 2001), and do to not allow land to have rest from grazing (Swinton *et al.,* 2003; Reardon & Vosti, 1995), or cumulative effects of animal numbers amongst multiple owners in communal lands leads to overstocking (IFAD, 2004). Whether the poor or the non-poor are causing overstocking in communal lands is arguable. Some studies credit the non-poor for having too many animals leading to overstocking (Swinton *et al.,* 2003; Reardon & Vosti, 1995), or blame poverty to cause livestock owners in developing countries to hold on to livestock as a storage of wealth (Moll, 2005; Doran *et al.*, 1979). The poor are contributing to this problem specifically by not being able to invest in the environment, through fallow periods or rotational

grazing (Swinton *et al.,* 2003; Reardon & Vosti, 1995). The inability to invest in fallow periods or rotational grazing was of interest in the study presented here since this can further lead to overgrazing. There is a clear relationship between poverty and overgrazing and it is important to understand this relationship to prevent further land degradation.

Comunidad vs. Ejido

While communal land management occurs with varied relationships to external government actors, internal governing structures could also influence behaviors and outcome of communal land management. The research comparing the conservation outcomes between *ejidos* and *comunidades* in Mexico is limited. Organizational structures affect the behavior of the institutions. Staatz (1987) argues that the unique structural characteristics of agricultural cooperatives is what leads them to behave differently than investor owned firms. Research comparing entire communal governance structures is limited, however research that compares aspects of these structures is more common. Campbel and Shackleton (2001) review different community based management structures in Southern Africa and find that traditional leaders still have a say after institutional reforms and post-colonialism. It was also found that some community based management systems work better when affiliated with local government and some worked better independently (Campbell & Shackelton, 2001). Greater participation in communities has been linked to adaptability and resilience (Robinson & Burkes, 2011). *Comunidades* normally have greater participation than *ejidos* since there is not necessarily a limit to one representative per family like *ejidos*.

Government Punishment

Government sanctions are one of the fundamental aspects of successful communal land management according to the seminal works of this field (Wade, 1998 & 1994; Ostrom, 1990). Local enforcement is not always successful although often promoted. At times external enforcement is needed (Ostrom, 2000). A system of external checks and balances is seen as having better sustained outcomes (Agrawal and Gibson, 1999). Checks and balance can be limited when external government enforcers do not always travel to remote areas (Ostrom, 1994). When comparing communal institutions across Southern Africa Campbell & Shackelton (2001) found that some community based management systems worked better when affiliated with local government and some worked better independently for sustainable outcomes. In a study in southern Mexico of an *ejido* in another National Park, external government monitoring and sanctioning was complimentary since the community did not have personnel or funding to monitor however it also complicated their monitoring process (Johnson & Nelson, 2004).

Park Promoted Conservation Practices

It is hardly known which strategies successfully alter the norms people hold about conservation, particularly when they are a part of the family income (Campbell & Berry, 1997). Negative attitudes are frequently associated with situations where the perceived costs to individuals and communities outweigh the perceived benefits (Frauman & Banks, 2011, Walpole & Goodwin, 2001; Lindberg *et al*., 1996). The distribution of the costs and the benefits may also affect attitudes, particularly if the

recipient perceives if he or she has not received a fair share. Tourism benefits, such as jobs, can have a greater effect than productive or aesthetic benefits because tourism is more apparent. Attitudes may also depend on the willingness of residents to accept governmental policy and the level of participation in protected area decision making by residents (Lindberg *et al.,* 1996). If there is a negative relationship between park promoted conservation and overgrazing, then park promoted conservation is promoting pasture conservation. If the relationship is positive, then the park does not successfully promote pasture conservation on the communal lands.

Hectares Permitted for Grazing

Small size, as a defining characteristic of a community, has been implicit in the literature since the beginning of the writings on communal land management (Agrawal and Gibson, 1999). Small groups have been cited for poor management of resources whereas large transitional groups have been cited to manage resources more efficiently (Agrawal, 1999). In Tigray, Ethiopia communal land that had smaller restricted grazing lands per household reported fewer violations, established penalty systems, and paid for a guard (Gebremedhin, 2004). Wilson & Thompson (1993) state that large grazing areas in semi-arid and arid *ejidos* in the North of Mexico are needed to provide resource mobility. Smaller grazing areas with high stocking densities in arid and semi-arid lands can cause famers to miss the rain and lead to failure (Wilson & Thompson, 1993). These previous studies clearly suggest that the size of permitted grazing areas has a potential impact on overgrazing.

2.2.2 Overharvesting

Overharvesting refers to the overuse of any natural resource other than pasture. SEMERNAT (2003) listed the main causes of land degradation in Mexico and their contributing percentages as; agriculture (39%), overgrazing (39%), deforestation (16%), and urbanization (3.5%). Half of Mexico (54.1%) has lands that are in *ejido* or *communal* tenure (INEGI, 2008). The majority of the remaining forests in Mexico (80%) reside in 8,000 *ejidos* and *comunidades* (Klooster, 2000). It is illegal to fell trees in communal areas without a government approved permit. Forest owning communities lost many of their rights to their forests during the four decades after world war two when the government gave monoposonistic rights to integrated logging and processing industries. Communities could no longer clear, cut, or burn forested lands but they could sell their rights for minimal stumpage fees to industry. After strikes to sign wood contracts and immense pressure from logging communities a Forestry Law was passed in 1986 that allowed communities to form their own logging business with government approval. Trees in communal areas can only be felled with permits from the government. Enforcement is stronger for pine and officials tend to look the other way when less than a truck load is felled for oak particularly for subsistence usage (Klooster, 2000). *Ejidos* are not always successful in preventing deforestation or overharvesting (Honey-Rosés, 2009).

It is important to understand what institutional characteristics can lead to overharvesting in communal lands in the park for water conservation and preservation of rare species in Mexico. In this section, I review some important factors that were

identified in the literature as contributors to overharvesting of natural resources. Because of their relevance, these factors are also incorporated in my survey questions and modeling to test their association with perceived overharvesting of natural resources in the study area.

Comunidad vs. Ejido

Ejidos and *comunidades* have been shown to have higher conservation habitat than private lands (Ortega-Huerta & Kral, 2007). *Ejidos* have been cited to promote conservation by preserving forests (Ortega-Huerta & Kral, 2007; Ellis & Porter-Bolland., 2008), birds, and mammal species (Ortega-Huerta & Kral, 2007). Ellis & Porter-Bolland (2008) compared two biosphere reserves in the Yucatan peninsula with *ejidos* and found that the biosphere reserve that had a long standing community forestry operation and long term planning for lands in the area had a negative deforestation rate from 2000-2005 and the other biosphere reserve had a deforestation rate of 0.7%. When comparing 11 protected Maya forests in Mexico and Guatemala with 19 community forests, Bray *et al.* (2008) found that deforestation rates were higher in protected areas than in community forests. The difference was not significant. There was also no significant difference in the deforestation in inhabited protected areas, recently inhabited community forests, in uninhabited protected areas, and uninhabited community forests. Under low colonization pressure, extractive communities that have been inhabited for a long time perform as well as strict uninhabited protected areas. This research shows that communal forests under low population pressure can be more economical and effective for conservation. Ortega-Huerta & Kral (2007) looked at the average percentage of

natural vegetation aggregation index, and the Shannon biodiversity index for different tenure arrangements in the gulf, plains, and mountainous regions in Mexico. When looking at the mountainous regions, private property has a biodiversity index of 1.87, *ejidos* 1.96, and *comunidades* 2.05. Thus, there was only a slight difference in the diversity index between the tenure types with communal land performing better. The aggregation indexes were high with private property at 87%, *ejidos* 89%, and *comunidades* at 93%. However the percentage of natural vegetation was quite low, with *comunidades* at 30% natural vegetation, *ejidos* 20%, and private property at 21%. *Comunidades* in mountainous regions performed better than *ejidos* and private property on all three indexes. Thus, it is questionable whether *comunidades* are more susceptible to overharvesting than *ejidos.*

Microfinance

Investment poverty is a concept that has been coined to signify the limited investment in natural resources that can further lead to degradation and subsequent poverty (Swinton *et al.,* 2003; Reardon & Vosti, 1995). Microfinance groups are a common strategy for development and poverty alleviation in developing countries. The question remains, however, how users will choose to use these funds. Microcredit is often used to buy pesticides, fertilizers, cattle, and land for activities that can have a negative impact on conservation. Microcredit can also be used for micro drip irrigation, self-help groups, agroforestry, and sustainable agriculture, for improved watershed management (Lal & Israel, 2006). In a reserved watershed in China, microfinance was used to enable those dependent on the resource to branch out into other businesses and to

reduce their dependence on natural resources, however it did not work (Herrold-Menzies, 2008). In Indonesia, microfinance was given to small fishermen to reduce fishing pressures and preserve coral reefs; while microfinance increased and diversified their incomes, it did not relieve fishing pressures (Brock, 2013). Jetti (2011), argues that microfinance is linked to the commons since, "a majority of the loan recipients of microfinance loans in the developing world make at least a part of their living by utilizing common pool resources (CPR) such as forests, fisheries, agricultural lands, mineral resources, waterways and the like." Research in this area has proven to be difficult, as many micro lenders do not keep documentation of what the loan was used for (Goldsworthy, 2010). Given the possible linkages between microfinance and degradation and the lack of quantifiable evidence, the presence of microfinance was included in the survey questions.

Presence of Other Organized Groups

Increased human organization can serve as a safeguard for conservation (Campbell & Berry, 1997). Brechin *et al.* (2002) expected to find that increased organizational capacity would be in line with the elements of the social and political process and would increase self-enforcement and reduce the need for forced compliance. Group formation has also been cited to increase connectedness; more levels of connectedness can lead to better outcomes. These connections can occur in different forms; local connections between individuals, local connections between groups, local group and external group connections (either one or two way relationships), external-external connections (leading to integrated approaches and collaborative partnerships),

and external individual connections (Pretty & Ward, 2001). These and implied connections to other groups in society from the macro and micro level improve outcomes (Uphoff, 1993; Grootaer, 1998; Woolcock, 1998). When Uphoff conducted a comparative study of 16 countries in Asia, the countries which had the best linkages between central government and rural communities through a network of local institutions had the best performance in agriculture and social indicators. Impressive differences were also found for nutrition, health, and education improvements (Uphoff, 1993). Groater (1998) found that associations and institutions provide and informal framework to organize information sharing, coordinating of activities, and collective decision making that can improve outcomes when not taken over by local overlords. Woolcock (1998) found that groups can have either the positive or negative aspects of social capital that can promote or halt development. To understand if local groups and social capital is increasing or decreasing overharvesting the presence of other groups was included in the survey.

Pasture Fencing and Natural Boundaries

In a study in South Africa fences were not only to keep out animals but also wood gatherers and hunters. The absence of fencing and grazing pressure led to denuded vegetation and topsoil, erosion in steeper slopes, and the spread of invasive and unpalatable species (Ainslie, 1999). In another study in South Africa, fencing and the absence of boys to herd livestock was stated to have led to degradation in rangelands (Fabricius, 2004). Fencing in Inner Mongolia has led to erosion (Williams, 1996). Todd & Hoffman (1999) observed the plant distribution around a fence that divided heavily

grazed communal lands and lightly grazed commercial lands in Namaqualand, South Africa. They did not find a significant difference in plant species richness. However, the richness in large palatable shrubs had decreased on the communal land (Todd & Hoffman., 1999). The literature often cites the need for fences, and, on the other hand, it also cites how fences lead to degradation. This factor is interlinked with the number of animals on the land.

Number of Parcels Sold to External Buyers

Several studies document the sale of *ejidos* corresponding to changes in land cover. Lambin et al. (2001) stated that changes in land cover result from "... peoples responses to economic opportunities, as mediated by institutional factors ..." In coastal ejidos in Senora, coastal wetlands have been sold and transformed into commercial shrimping farms (Luers et al., 2006). In the Yaqui Valley, a major wheat producing area of Mexico, 95% of Ejidos have been sold or rented out and there has been a corresponding increase in the intensification of wheat cultivation (Matson, 2012). Ejidos are often sold legally or illegally when located near urban areas (Ojeda-Revah, 2008). Since ejidos and comunidades have been shown to have higher conservation habitat than private lands (Ortega-Huerta & Kral, 2007) , it is questionable how there change in ownership might affect conservation.

2.3 Perceptions in Following the Rules

Trust in others to follow the rules can increase cooperation from a resulting sense of social obligation (Pretty & Ward, 2001), and can reduce transaction costs for rule enforcement. Trust takes time to build and is easily broken (Gambetta, 1988;

Fukuyama, 2008). When distrust infiltrates a society, cooperative arrangements are unlikely to emerge (Baland & Platteau, 1996). Trust, reciprocal arrangements, locally developed rules, norms and sanctions, and emergent institutions have been clearly shown to deliver biodiversity dividends in many contexts. Thus, it is important to blend both biological and social elements for conservation (Pretty & Smith, 2004). Trust in members to follow the rules may be influenced by factors such as community transparency, hectares permitted for grazing, communication frequency about natural resource management, rules made by the community, and if rule breakers are punished.

2.3.1 Independent Variables

Community Transparency

Transparency is as a tool to fight off corruption. Corruption is the abuse of entrusted power for private gain. Mexico received a score of 34 (out of 100) in the corruption perception index in 2013 (Transparency International, 2013). Transparency was included in this study not only because it is an essential component of governance but also due to its reference in literature as an essential component of communal land management (Child, 1996; Blaikie, 2006; Nelson & Agrawal, 2008). Good governance is important for improved conservation outcomes. Transparency is a measurement of good governance that is frequently used amongst the World Bank and in international development projects (Balint, 2006). When leaders are transparent, it improves trust among their followers (Norman *et al.*, 2010). Organizational transparency has also been shown to lead to greater levels of trust (Rawlins, 2006). However, Grimmelikhuijsen (2012) found that transparency could lead to lower levels of trust if people are

disappointed with the low degree to which the government is transparent.

Hectares Permitted for Grazing

Baland & Platteau (1996) and Wade (1988 & 1994) referred to small land size as an indicator for success for communal land management. The size of a community and its resource base have been written about since the beginning of the writings in this field (Agrawal and Gibson, 1999). However, size alone is not a determinant of success. Other factors must be taken into account when looking at size. Several authors have indicated that in smaller areas users can communicate more frequently, thus lowering the transactional cost of rule enforcement (Baland & Platteau, 1996; Wade, 1988 & 1994; Agrawal and Gibson, 1999). Communal grazing areas vary in nature; some are covered by forests (tree felling in communal areas without a permit is illegal), have streams, shrubs, and medicinal herbs. Regardless of cover, the designated communal area in *comunidades* and *ejidos* is generally used for grazing. Larger resource bases can often be more costly to monitor and could lead to reduced trust in following the rules. To understand the relationship between resource size, monitoring, and trust the number of hectares permitted for grazing was included in the survey questions.

Communication Frequency about Natural Resource Management

Communication frequency around natural resource management can have a possible influence on trustworthiness of members to follow the rules. In a study conducted amongst trustee's and trustors, the level of perceived trustworthiness was found to be affected by the frequency of communication (Becerra & Gupta, 2003). In another study examining the complex relationships between superiors and subordinates,

fairness perceptions were found to often be constructed by workgroup members through discourse (Sias & Jablin, 1995). When there is conflict in communal management, communication is promoted to understand each other needs, drain frustration, and transform negative stereotypes. Through interactive conflict management, communication can build trust (Upreti, 2002). In the communal land management literature many authors refer to small size as important, when they are referring to the reduced transactional costs for rule enforcement (Agrawal and Gibson, 1999).

Rules Community Made

Wade (1988 & 1994) and Ostrom (1990) talk about the importance of rules being locally devised and having access to and management of the rules. Locally developed rules along with trust and norms and sanctions have shown to deliver biodiversity dividends in many contexts (Pretty & Smith, 2004). When users are genuinely engaged in decisions regarding rules affecting their resource use, the likelihood that they will follow the rules and monitor others is much greater than when an authority simply imposes rules (Ostrom & Nagendra, 2006). Much of the literature supports local rule creation since there is the ability to modify rules when needed and negotiate claims (Cleaver, 2007). Studies have observed inequitable relationships of resource utilization by poorer users when the rules are externally made (Leach, 1999). It was apparent that communities in the park had different levels of external involvement. To understand how this external involvement affects rules, a question regarding local rulemaking was included in the survey.

Rule Breakers Punished

Government sanctions are part of the signature work of Wade (1988 & 1994) and Ostrom (1990). Baland & Platteau (1996) refer to rule punishment as the ease in enforcement of rules. As mentioned previously, Pretty & Smith (2004) found norms and sanctions to deliver biodiversity dividends in many contexts. In an experimental social dilemma, when groups are competing for members, groups who do not adopt a sanctioning system find their joint earnings dissipating and groups who adopt a sanctioning system obtain higher outcomes and draw new members from other groups (Gurek *et al.*, 2006). Vollan (2008) found that penalties work best in a low trust region and crowds-out co-operation in a high trust region. Rewards work well in a high trust region and they do not work well in a low trust region. It was also found that a society with a cultural tradition of strong norms on trust and reciprocity can be negatively influenced by restrictive external interventions. If the community is one where people do not initially trust each other, the external penalty rule is likely to perform well. How punishment affects members trust in others to follow the rules needs further exploration.

CHAPTER III

METHODS

3.1 Study Area

Mexican *ejidos* and *comunidades*, two communal management systems, were considered in this study. The Mexican federal office *Reforma Agraria* provided the locations of seven *comunidades* that were located in close proximity to each other, so that they were ecologically similar. These seven *comunidades* were located inside or had part of their boundary in the National Park "Cumbres de Monterrey". There were also thirteen *ejidos* in the area, five of which were located completely inside the park and eight were located partially inside the park. Given their close proximity and similar ecosystems, these *comunidades* and *ejidos* were subject to many similar external social, physical, and institutional forces, reducing the number of variables that had to be considered in order to measure their potentially different impacts. However, for this study some *ejidos* were not included for the following reasons: they were sold in their entirety, all the members had left and fled to the city, or they were inaccessible by car. For this study, seven *comunidades* were surveyed of which two were partially outside of the park, and seven *ejidos* were surveyed of which two were also partially outside of the park. One of these *comunidades/ejidos* had the same name and has been split into two different management regimes. Hence, they were separated in this count since they function as separate entities. Refer to appendix B for a map of the park as well as the community boundaries.

The formation of the *ejido* emerged out of the Mexican Revolution of 1910-1915. The *ejido* is a well-defined system of common property rights that was used by the Aztecs at the time of the Spanish conquest. The *calpulli* is a group or community of individuals (usually with family or lineage ties), which controlled a set area of land and managed under individual usufruct (Sanderson, 1984). Spanish and Mexican rule eliminated this system by making land grants and land concessions to elites. These concessions steadily increased because of Mexico's growing agricultural demands, reaching their peak in the *Porfiriato* period between 1876 and 1910. In fact, by 1910, one-half of the Mexican rural population were indebted agricultural laborers in *haciendas.* Haciendas are closely-knit feudal estates that were created by the Spaniards (Chevalier, 1963). Agrarian reform was one of the major driving forces behind the Mexican Revolution of 1910-1915. The first Agrarian Reform act of 1915 stipulated the common property system of the *ejidos* and gave the government the power of expropriation or eminent domain of all lands. Individuals living on abandoned *haciendas* were granted the land by regulations established in 1922. Land re-appropriation went through cycles stimulated by pressure from landless rural people, with peak re-appropriation in 1930, a nadir in the 40s and 50s, and then another peak in the 60s and 70s (Wilson & Thompson, 1993).

However, prior to the 1990s Mexico was a net importer of food. Thus, in 1992 article 27 of the Mexican constitution was amended, allowing for the sale of individual parcels (*solares)* and individual agricultural plots (*parcelas*) in *ejidos.* With community agreement, members are also permitted to sell communal grazing areas. Upon the death

of the *ejido* member, the rights are passed on to only one family member. The highest power in the *ejido* is the *asamblea* (assembly) that is comprised of all *ejiditarios*. Decisions are made by majority vote. The *asamblea* ideally should meet once a month or at the greatest frequency possible. All finances and decisions are to be made transparent to the *asamblea* in the meetings. The next highest power is the *comisariado* (president) who has to live and work inside the *ejido* six months prior to election and has to work in the *ejido* during his term in office. Next is the *consejo de vigilancia* who also is elected to power and who has the responsibility of monitoring resource use and the compliance of community members with community rules.

Comunidades agrarias, on the other hand, are a different form of communal land management in which members are allowed to determine the divisions of the community and the organizational structure. Communal rights generally pertain to every family member in the community and can be determined by the community (Ley Agraria Articulo 100, 1992). Thus, the size of a *comunidad* can continue growing as rights are not passed on to one family member like an *ejido*, Since they are more flexible in structure they do not always have a designated communal grazing area and individual parcels. If they do, they are not always held on record by the department of agrarian reform like *ejidos*. Property rights are more loosely defined in *comunidades* than in *ejidos*. *Comunidades agrarias* were created by the government in general for indigenous communities (Procuraría Agraria, 2006). *Comunidades* are allowed to adopt the organizational regime of an *ejido* if they so desire and thus are able to sell land if

registered as an ejido (Ley Agraria Articulo 98, 1992). A few communities in this study have applied and have been waiting to receive *ejido* status.

Ejidos control approximately 40% of agricultural lands in México. On average, *ejidos* are 30-50% less agriculturally productive than private lands. Thus, many see privatization as an opportunity for increased agricultural productivity (Wilson & Thompson, 1993). However, Wilson & Thompson (1993) argue that "agricultural production in semiarid and arid zones requires resource mobility, particularly the freedom to graze livestock throughout a large, extensive land area." Common grazing lands therefore represent a hedge or insurance against uncertainty in rainfall patterns. They also conclude that "…the breakdown in *ejido* productivity on these extensive, livestock-herding areas is due to the deterioration in property management at the community level." They hypothesize that *ejidos* can behave like open access systems when leaders are unable to enforce rules. Coronado-Quintana *et al*. (2001) have shown that *ejidos* can be just as productive as private lands, and are more affected by their infrastructure (road and well access) than by their organizational structure (private vs. *ejido/*communal) (Coronado-Quintana *et al*., 2001). The lack of infrastructure development and consequent decreased productivity could be a strong reason why *ejidos* and *comunidades* are shown to have higher habitat conservation than private lands (Ortega-Huerta & Kral, 2007)**.** However, as of yet, no one has looked at how the organizational structure and strength may affect overgrazing and overharvesting of natural resources.

Cumbres de Monterrey National Park is located in the northeast of the Sierra Madre Oriental geological province. The Sierra Madre Oriental geological region extends on the north to Big Bend National Park in Texas and to the south to the Southern Volcanic Belt in Mexico (López-Ramos, 1979). In this part of the geological province, many mountain peaks reach approximately 3,400 meters above sea level (SEMERNAT, 2009). The Sierra Madre Oriental mountain range is composed of sedimentary rock that varies in age from the tertiary period (ITESM, 1994). The park is located in the Rio Bravo - Conchos hydrological region inside the Rio Bravo- San Juan watersheds. Tributaries and water drain into the Rio Bravo, San Juan, and Pesquería rivers. The principal river in the park is the Santa Catarina that collects about eighty percent of the hydrologic resources of the region. The Rio San Juan watershed supplies the majority of the surrounding urban areas with water. Inside the park, there are many factures, faults, and permeable geologic structures that make this area a watershed recharge zone. The climate in the park is defined by the corresponding physiographic locality. In the highest areas of the park temperatures oscillate between -3°C y 18° C, Celcius in the winter months of November through January (CONABIO, 2008). Lowland areas of the park at 400 meters above sea level will reach maximum temperatures of 32°C while the highest parts of the park will reach 26°C and 27°C in the months of June and July (SEMERNAT, 2009).

Dry winds come in from the west and create a dryer climate in the northwestern part of the park where the landscape is characterized by many dry land plants. In the highest elevations of the park where the slope permits tree growth, intact fir and spruce

forests can be found. In the lower parts of the park near rivers, sedentary agriculture is found. Throughout the park pine and oak forests are found. A sub-mountain shrub ecotone is found throughout the park on hillsides and indicates a forest transition. According to the Mexican National Institute of Statistics and Geography the majority of the park falls into this classification and is found principally in the northern part of the park where there are steep slopes and strong winds (INEGI, 2005). The height of its cover varies from 2.5 to 5 meters. In areas with tree cover, *Helietta parvifolia* and *Acacia berlandieri* are found. In areas with shrub cover *Leucophyllum frutescens* and *Acacia ridigula* can be found. On a smaller scale *Agave lechuguilla* and *Euphorbia antisyphilitica* are found throughout both. The tree species that are found throughout the park are principally *Pinus pseudostrobus*, *Abies vejari*, and *Picea martinezi*. Other species that are also found throughout are *Quercus polymorpha*, *Q. rysophylla, Q. graciliformis*, *Q. laeta*, *Q. mexicana*, *Q. rugosa*, *and Q. laceyi* (SEMERNAT, 2009).

The park has federally protected forests with fir and spruce species that are not common in Mexico. A lumber mill used to exist in an *ejido* where the protected fir and spruce forests are located. Felling live trees in the park is not legal and many respondents mentioned having permit requests for felling denied. As mentioned prior, the park is located on a water recharge zone that provides 70% of the water for the city of Monterrey (CONANP, 2013) and land degradation is linked to water shortages (Duda, 2003; Ripl, 2003). The central plateau, to the west of the park, is the most severely affected area in Mexico from desertification (Manzano *et al.*, 2000). Appendix D has a map of the land degradation in Mexico created by SEMERNAT (2004).

3.2 Research Design

3.2.1 Key Concepts, Variables, and Measurements

The key concepts of this research were perceptions of park promoted conservation, overharvesting natural resources, overgrazing, and trust in members to follow rules. These variables were measured using household surveys with face-to-face interviews. The survey can be found in Appendix C. Park promoted conservation was at the end of the survey due to the controversial nature of the subject from often-tense park relationships. The question was stated as; "How has the park affected your natural resource management practices?" The available answers were: toward more conservation, no impact, toward less conservation. To measure overgrazing the following question was asked, "Do you think that pasture is overstocked with animals or overgrazed by community members?" This was a binary question with a yes or no response. The question to measure overharvesting states, "Do you think that other resources are overharvested or that the demand is too high?" This was also a binary yes or no question with an open-ended follow up on what types of resources the respondent mentions. Few people chose to answer the follow up question, many simply stated "natural resources" and the question was left blank. The usage of wood in the park was a contentious issue. Surveyors constantly assured respondents that they were not associated with the park or the government so that respondents would be willing to take the survey. The question regarding trust to follow the rules was also placed on the last page since it is a sensitive question. The question states: "How well do you trust

community members to follow the established rules?" The response options are: never, sometimes, usually, and always.

These key concepts serve as dependent variables in this study. Institutional success was defined as the level of trust in members to follow the established rules. The responses "usually" and "always" were considered as institutional success whereas "never" and "sometimes" were defined as institutional failure. Baland & Platteau (1996), Wade (1988 & 1994) and Ostrom (1990) talked about the ease in the enforcement of the rules, but did not directly state that trust in members following the rules was necessary for successful communal land management. Thus, this new concept was tested as part of the present study. Sustainable management was defined as the absence of overharvesting and overgrazing. Park promoted conservation refers to how the establishment of the park has affected respondents natural resource management practices. Positive park relations are important to reduce conflict and ideally to reduce rule breaking. These key concepts were used as dependent variables in my models.

Important independent variables were also measured to test their relationship with the key dependent variables. The main independent variables were also measured include: natural resource collaboration, compensation for conservation, respect from external government actors, transparency, and influence on community decision making. Baland & Platteau (1996) and Wade (1998 & 1994), stated that interdependence among group members is an important group characteristic for communal management success. However, this concept was difficult to measure. Here, the concept was evolved into collaboration and specifically asked as the frequency in which members talk to each

other about natural resource management. The frequencies listed for selection were: every few months, monthly, weekly, and daily. Another measurement used to asses collaboration was whether or not the community practiced rotational grazing since practicing rotational grazing takes greater community collaboration than operating individually. Since individual parcels were small, this means that animals were being either rotated between individual plots or that the communal area had been subdivided and animals were being rotated.

Appropriate levels of external aid are needed to compensate local users (Baland & Platteau, 1996). This study did not look at the appropriate levels since compensation is not a common practice in the study area and happens only in a few select communities. Compensation is given when communities had federally protected spruce and fir forests, when select members were asked to help stop forest fires, plant trees, or maintain emergencies. Only one community stated that some members had parcels in the federally protected forests with spruce and fir who were eligible for federal compensation. The majority of compensation was given as payment for work rather than payment for behavioral adaptation of current resource practices. Rather, the presence of compensation was observed to see the effect it had on users and their perception of park promoted conservation. Many authors have discussed the importance of conservation compensation for park inhabitants over authoritarian regulation (Coria & Calfucura, 2012; Infield & Namara, 2001). Two forms of compensation were explored here in this study: whether or not respondents have received compensation for

conservation activities, and the number of external trainings respondents have received in a year.

Wade (1998 & 1994) and Ostrom (1990) reported that to achieve communal land management success central governments should not undermine local authorities. Baland and Platteau (1996) stated that there should be supportive external sanctioning institutions. This was measured by two questions. The first was; "Do other governmental authorities respect the decisions of local authorities?" and the second was; "Do other governmental authorities and institutions support local punishments for rule breakers?". This was measured with a binary yes or no response. Note that this measured external support of punishments and the decisions of local authorities specifically.

Baland & Platteau (1996) mentioned the importance of accountability of monitors and other officials to users. Here this was measured as transparency. The question states "Is the community managed in a transparent way?" The response options were: never, sometimes, usually, and always. This was measured because corruption is a huge problem in Mexico. Mexico received a rank of 106 of 177 countries in 2013 by transparency international (Transparency International, 2013).

Baland & Platteau (1996), Wade (1988 & 1994), and Ostrom (1990) each mention the importance of locally devised access and management of rules. To incorporate this concept and to further test corruption, the questions was stated as "Is your opinion influential in the community decision making process?" The options were: never, sometimes, usually, and always. It was evident from the experience on the

ground that responses to this question varied from community to community. There were several other variables that were measured as well regarding this topic such as the number of years the leader has been in his position, if there was a term limit, if rules were just, and how often community members meet.

3.2.2 Survey Questionnaire

Introduction

Face-to-face surveys were conducted to solicit the data needed for this study. The survey questionnaire (Appendix B) was comprised of sixty-three questions that assessed the indicators for measuring institutional and ecological success along with the socio-demographic characteristics of the respondents and other variables. This has been explained in the key concepts, variables and measurements section above. The survey questionnaire was pretested with university students. A reliability analysis was conducted on the pretest survey results as a measure of internal consistency using SPSS (IBM Corp, 2012). Questions with a Cronbach's α greater than 0.7 were modified. Survey questions were generated using the Dillman (2007) text as guidance.

Collection

Surveys were conducted during daylight hours ranging from 7am to 6pm in the month of January 2010. Many of the community members went to the city to work as temporary laborers during the winter. Due to travel time in some communities, surveys occurred before and after lunch time. It was not safe to drive at night since roads go through steep mountain terrain with limited lighting; water froze in some parts of the

park at night. Escalating violence and insecurity did now allow for follow up surveys.

Agricultural Production

Respondents were livestock owners, mainly owning; donkeys, horses, cows, and goats. Communities in the central region of the park often grew apples or other stone fruit trees due to the cooler temperatures available at higher elevations. Preserves were sold on the main roads near tourist points. Communities on the south east border of the park grew pecans and had higher quality housing in general. The community of La Trinidad on the eastern part of the park, at a very high elevation, grew fir trees, and had protected forests from the UN and the government. There used to be a timber mill located there, as there was a very dense conifer forest. The mill was closed due to felling restrictions, which resulted in unemployment.

Survey Format

The questions were ordered by theme predominantly. Questions that were more sensitive were put later in the list of questions. The survey started out by asking if respondents were part of an *ejido* or *communidad*. If respondents stated no, then the survey was terminated. If respondents were part of an *ejido* or *comunidad*, they were then asked if they grazed animals in the communal area. If respondents did not own animals or had not owned animals that utilized the communal grazing area, the survey was terminated. For respondents who had livestock, the survey then went into general livestock and pasture management questions. After this, the questions revolved around the presence of different types of groups in the community. At this point the survey transitioned into institutional questions regarding meeting frequency and attendance,

opinion influence, leader experience, transparency, rules that were just, the participation of women in rule making, term limits, and term years. The respondents were then asked questions revolving around economics; how much members helped each other, access to microfinance, annual livestock earnings, and the number of adults and children in the family. The survey then returned to natural resource restrictions since a general relationship and comfort level would be established at this point. Questions relating to natural resource restrictions were: the presence of natural resource restrictions, if restrictions helped regeneration, pasture fencing and natural boundaries, pasture rotation, community infrastructure, and animal types. Questions regarding the relationship with external government actors were then asked regarding respect, punishment, conservation compensation, participation in federal assistance programs, and the number of years of school attended. The respondents were then asked about the presence of overharvesting and overgrazing and several questions regarding rules and restrictions. Questions about rules were separated into different sections to assure that respondents did not answer the same to all questions regarding rules, particularly since it is a tense and complicated subject. The survey ends with questions regarding the number of properties sold, if respondents thought there community was better than other communities, the respondents perception on park promoted conservation, how the park has affected their wellbeing, the number of trainings received, and how household decisions were made.

3.2.3 Sampling Methods and Sample Size

The sampling methods used here was multistage sampling since there was not an adequate list of individuals in the study population (Fowler, 2009). Maps provided from

the Department of Agrarian Reform helped us navigate the location of the communities. Some communities had dirt roads on steep terrain that varied in condition due to weather and some communities did not have roads making their access impossible. Upon arrival, the number of households present was assessed along with the proportion to the total population. Surveys were attempted at all households because many people were absent due to migratory labor. In Laguna de Sanchez a small human settlement was not surveyed since there were not any roads leading there and we did not have a guide to help us access the small human settlement. Other small human settlements in the mountains of Laguna de Sanchez were sampled. There are more survey responses from this community than any other due to the fact that it had the largest population and human settlement in the park. Due to the large representation of samples for *Laguna de Sanchez* and the inclusion of many communities that were difficult to access, the chance for bias from the exclusion of this one human settlement is low.

In some communities people showed resistance towards surveyors and thus snowball sampling had to be used. This method used the approach where the first respondent identifies people the surveyor should talk to next (Trochim & Donnelly, 2007). This occurred in *La Cieneguilla* and in half of the surveys in *Paso de Guadalupe y Mariposa* . However, it needs to be noted that surveys were attempted in all houses for both methods. These were the only communities in which people would not talk to us. Five households in *Paso de Guadalupe y Mariposa* would not talk to us, and 10 householeolds in *La Cieneguilla* would not talk to us. In communities in the park with higher tourism and access to major roads and population centers, there was a strong

belief that the National Park Service would like to get rid of all farm animals. Due to the fact that members in this community believed that researchers were affiliated with the Park Service, snowball sampling initially had to be used there. In an effort to gain more survey participants in *La Cieneguilla* and parts of *Laguna de Sanchez*, participants were asked if they previously had animals in the communal area rather than currently, so that respondents would be more willing to talk to us. Apparently, having animals in *La Cieneguilla* was a controversial issue. It was located near an urban area in the main entrance to the park that received many tourists. The community owned a waterfall that tourists would pay to view. In general, park respondents were afraid that the park would take away their animals since there have been complaints by tourists about livestock in the road or near streams. This community was particularly more sensitive to this issue than others.

Community members who lived permanently outside of the community yearlong were excluded from this study because of their inaccessibility. In many of the communities, a sub-population lived outside of the community year round in surrounding urban areas (Monterrey/Saltillo/Villa de Santiago) on a permanent basis, but still attended communal meetings. The majority of these members no longer exploit natural resources. People who conduct intermittent migrant work outside the community but still lived in the community on an intermittent basis were included in the study since they often attended community meetings and utilized community natural resources. In several communities, absentee members were eliminated from community meetings.

Several communities were severely affected by migration to the cities, so much so that their inclusion in the study was not feasible. These communities were *Mauricios, El Alamo, and El Pajonal*. *Emilio Carranza*'s road was in poor condition and was inaccessible at the time. Thus, this community was not included in the study. Two communities (*La Cienega and El Potrero*) were sold in their entirety; thus they were not sampled. The *ejidos* that were included in this study are: *Cieneguilla, La Trinidad, Laguna de Sanchez, Pablo Sidar, Paso de Guadalupe y Mariposa, Real de Canada y Anexos, and San Jose de las Boquillas*. The *comunidades* that were included in this study are *Canoas, Laguna de Sanchez, Mireles y Anexos, San Antonio de las Osmenta, San Juan Bautista, San Sebastian, and Santa Cruz*.

Although a census sampling methodology attempts to survey all members, due to the fact that respondents were not always available a sample size formula was used. To ensure that an appropriate confidence interval could be achieved, so that the sample was statistically adequate. The national park estimates that there were 9,335 park inhabitants in 2008 (CONANP, 2007) and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) stated that the park had 2,000 inhabitants (UNESCO, 2011). Given the disparity between the population estimates by the national park and UNESCO, I also attempted to estimate the population in the survey to ensure the sample size was large enough. The population was estimated by asking community members about their community population ~~on~~ during the survey and then selecting the median of all responses. The average was perceived to be skewed since in some responses certain individuals gave answers that are substantially larger or smaller than the norm. Thus,

the population responses were only utilized for this study for the descriptive statistics. The UNESCO population number was used for the sample size formula.

Power is the ability of a statistical test to detect the effect if the effect exists (Cohen, 1988). There are two types of power alpha (α) and beta (β) that help define the probability of error. Alpha (α) defines the type I error in which there is an incorrect rejection of the null hypothesis. Beta (β), type II error, is the probability of falsely accepting the null hypothesis when the alternative hypothesis is true (Neyman, 1952). The alpha in this study was set to .05 and the beta .7. The standard deviation (S) for the population was unknown so an S of .5 was chosen. This is a conservative estimate since $S^2 \approx p(1-p)$, which attains its maximal value when p = ½. The margin of error (e) is .08. The sample size formula used is (Kuehl & Kuehl, 2000):

$$n_0 = \left(\frac{(Z_\beta + Z_{\alpha/2})^2 S^2}{e^2} \right)$$

where Z_α is the value associated with the confidence level which is 95% for this sample and thus Z takes a value of 1.96 (Zar, 1984). Z_β is 0.5238 from the Z table. Based on this formula, a sample size of 241 was desirable. However, since this is a finite population, a finite filter was used (Lohr, 2010).

$$n = \left(\frac{n_0}{1 + \frac{n_0}{N}} \right)$$

With a n_0 of 241 and an N of 9,335 this gave an n of 235. With a n_0 of 241 and an N of 2,000 this gave an n of 215. We collected 235 surveys from this population. The dataset had a total of 61 women respondents, which was about 25% of the total sample.

3.2.4 Survey Implementation

Face-to-face interviews were adopted to facilitate communication and increase the response rate. Three surveyors conducted household surveys for this population, including Kathryn Clifton, Alfredo Dafne Ramirez, and Antonio Hernandez. Surveys were checked upon completion. There were certain questions that were frequently left blank primarily because the respondent did not want to answer or did not know the answer. These questions were left blank. Originally, we planned to sample every other house due to simplicity in implementation. However, upon our arrival in the field it became apparent that many people were away working in the city. Thus, every household in the community was sampled so that a statistically significant sample could be achieved. A household was defined as a couple who was married or widowed with any dependent children. If a separate married couple lived in the same building, they were a separate household.

3.3 Survey Data Analysis and Hypothesis Testing

3.3.1 General Approach

Analysis of data included descriptive statistics, binary logistic regression, and ordinal logistic regression also known as polytomous regression. Descriptive statistics were important to understand the different socioeconomic realities in the park and common trends among respondents. This was helpful in specifying and further interpreting the binary and ordinal logistic models. A normal distribution is not required for a logistical regression model (Agresti, 2007). Ordinal logistic regression was used for questions that had scaled responses. Binary logistic regression was used to test the

relationship between variables when the dependent variable was dichotomous. All regression models were estimated using the backward step-wise Wald approach.

Binary logistic regression is a statistical method for describing the interrelationship between a dichotomous dependent variable and multiple independent variables. The model can be written as (Agresti, 2007):

$$logit[\pi(X)] = log\left(\frac{\pi(X)}{1-\pi(X)}\right) = \alpha + \beta X$$

where π(X) represents the probability of selecting the dependent variable. X is the vector of the independent variables and β is the vector of regression coefficients associated with X, it is also the slope and measures the steepness of the regression line. The intercept α, measures the value where the regression line crosses the y axis. A Wald test was used to perform backward stepwise regression. This is helpful in eliminating independent variables that do not have a statistically significant relationship with the dependent variable. The (1-α) confidence interval of estimated β (Agresti, 2007) is:

$$\hat{\beta} \pm Z_{\alpha/2}(\text{SE})$$

Where $\hat{\beta}$ having a chi-squared form depends on the curvature of the log-likelihood function at the point where it is maximzed. A greater curvature gives a smaller standard error (SE). The area under the standard normal curve on each side of the normal distribution tail is $Z_{\alpha/2}$. The asymptotic distribution of the Wald statistic is chi-square with degrees of freedom equal to the number of parameters estimated (Agresti, 2007). The Hosmer-Lemeshow test of goodness of fit is obtained by conducting a chi-square test on a 2 x g contingency table. The contingency table is constructed by cross-

classifying the dichotomous dependent variable with a grouping variable (with g groups) in which groups are formed by partitioning the predicted probabilities using the percentiles of the predicted event probability (Hosmer & Lemeshow, 2000). The Hosmer-Lemeshow goodness-of-fit statistic (Hosmer & Lemeshow, 2000) is computed as:

$$H = \sum_{g=1}^{n} \frac{(O_g - E_g)^2}{N_g \pi_g (1 - \pi_g)}$$

The *p* value is given by Pr ($\chi^2 \geq \chi^2_{HL}$) where χ^2 is the chi-square statistic distributed with degrees of freedom (*g*-n), the default value of n is 2 (SAS Institute, 2011). This is helpful in determining which model has the best fit. Only models that had a significance of p> 0.05 were interpreted. Collinearity diagnosis were conducted for the models to assure that the independent variables were not inter-related. A variance inflation factor (VIF) of less than three was obtained for all variables, indicating that there was no statistical evidence of collinearity in the final models selected.

Ordinal logistic regression was run for all models with scaled responses. While multinomial logistic regression can be used, ordinal logistical regression results have simpler interpretations and potentially greater power than baseline-category logit models. A cumulative probability for *Y* is the probability that *Y* falls at or below a particular point. For outcome category *j*, the cumulative probability is (Agresti, 2007 p. 180):

$$P(Y \leq j) = \pi_1 + \ldots + \pi_j, \quad j = 1, \ldots, J$$

The score test for the proportional odds assumption was used to determine the goodness of fit. This tested whether the parameters are the same across logits, simultaneously for all predictors. Models with score values of Pr > ChiSq greater than 0.05 were interpreted. The model used for the score test for the proportional odds assumption was the same as the cumulative logit model, and it is (Agresti, 2007):

$$logit[P(Y \leq j)] = \alpha_j + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k, \qquad j = 1,2,3$$

A cumulative probability for Y was the probability that Y falls at or below category *j*. The above formula shows the cumulative probability for j. In this model, *βk* is the increase in log-odds of falling into or below any category associated with a one-unit increase in *Xk*, holding all the other *X*-variables constant. This model uses cumulative probabilities up to a threshold, thereby making the whole range of ordinal categories binary at that threshold. The response is *Y=1,2,..., k* where the ordering is natural. x_1, x_2, x_k are indicator or dummy variables, they indicate categories for the predictors. Multicollinearity tests were run for all models, and variables are removed that have a VIF of three or greater. This is to assure that explanatory variables in the regression models were not highly correlated one another. The formula used is (O'Brien, 2007):

$$tolerance = 1 - R_j^2 \ , \ VIF = \frac{1}{tolerance}$$

where R_j^2 was the coefficient of determination of a regression of dependent variable *j* on all independent variables. A tolerance of less than 0.20 or 0.10 and/or a VIF of 5 or 10 and above indicates a possible multicollinearity problem (O'Brien, 2007). In this study, the independent variables with a VIF greater than or equal to three were removed.

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Descriptive Statistics

4.1.1 Demographic, Socio-Economic, and Political Overview

Organizational Structure

There were more *ejidos* than *comunidades* in the park. The park had the highest concentration of *comunidades* in the state of Nuevo Leon. *Comunidades* had a looser organizational structure where all members of the family can continue to be part of the communal land and have the same right of ownership as other members. Often individual parcels and communal grazing were not as strictly defined as required in *ejido* systems. One community in particular had both a *comunidad* and *ejido* structure in different parts of the community but is known as one entity. It also had the largest population in the park. One *comunidad* was in the process of registering for *ejido* status so that members of the *comunidad* could sell individual parcels. Of the respondents 59.7% were from *ejidos,* 24.2% from *comunidades,* and 15.3% from both. See figure 1 for the response rate from both organizational structures.

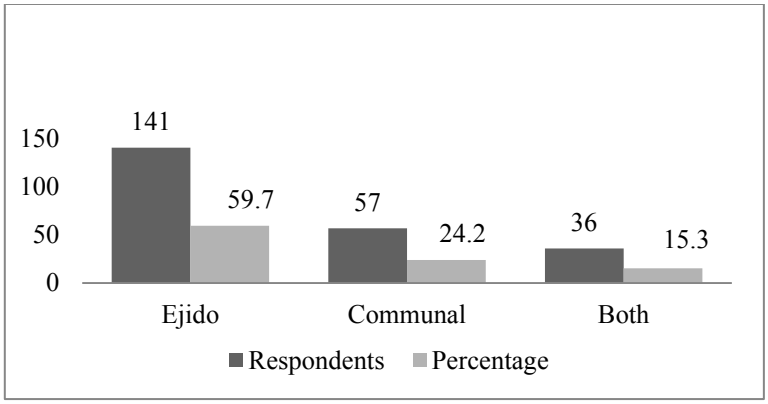


Figure 1. Responses from Different Organizational Structures. The dark grey bars represent the number of respondents for each land tenure type. The light grey bars represent the percentage of respondents for each land tenure type.

Demographic Characteristics of Respondents

The majority of the survey respondents were male 74.9%, and only 25.1% were female. This reflects the fact that the majority of the *ejidos* had a male family member that attended the community meetings. In general, women only attended *ejido* meetings if they were a widow or if their husband was unable to be present. Many of the respondents (57.4%) received governmental assistance; the programs that received the greatest enrollment were *Oportunidades* and a pension program for the elderly with SEDESOL (*Secretaría de Desarrollo Social*- Secretary of Social Development). *Oportunidades* is a national program that pays mothers when their children attend school with minimal absences and when they attend doctors' appointments. The SEDESOL pension program is a program that assists the elderly ages 65 and up. The age of respondents was not asked however; it appears that the park was inhabited by elderly people and the majority of the younger generation appeared to have gone to the city or other areas in search of other opportunities. It was not surprising that 41.4 percent of

respondents did not have children in their households. Some 40.3 percent of the respondents had 1-2 children in the household. Many respondents stated that they had multiple adult children. If the older children were not dependents they were not included in the household count in Table 1. Access to schooling varied by community. The absence of a school or only a remote school, with a television for instruction, was common in small communities at high elevations that lacked paved roads. When talking to a teacher in the park it was apparent that they struggled to recruit teachers in many locations throughout the park. Respondents were asked how many years of schooling they attended. The numbers were then grouped into correspondent categories of primary, middle, secondary, and collegiate. Please note the percentage response does not represent the completion of any of these categories. Given the poor accessibility of school in some locations, it was not a surprise that 12.6% of the respondents have not attended school and 53.3% have attended primary school at one time (Table 1). Only 7.8% of the respondents attended secondary school (high school).

Table 1. Demographic Characteristic of Respondents

Percentage of Response (%)			
Gender		Government Assistance	
Male (n=176)	74.9	Yes (n=134)	57.4
Female (n=59)	25.1	No (n=101)	42.6
Children in Household		Years of School	
0 Children (n=84)	41.4	No Schooling - 0 Years (n=29)	12.6
1 Child (n=14)	16.3	Primary - ≥1 and ≤6 (n=117)	53.3
2 Children (n=49)	24.1	Middle - ≥7 and ≤ 9 (n=56)	24.3
3 Children (n=17	8.4	Secondary - ≥10 and ≤ 13 (n=18)	7.8
4 Children (n=15)	7.4	Collegiate - ≥14 and ≤ 19 (n=9)	3.8
7, 9, 10 Children (n=5)	2.5		

Livestock Profile

The survey respondents were actively engaged in agricultural activities; however very few relied on agriculture for the majority of their income. Figure 2 shows that many of the respondents (45.1%) relied on agriculture for only 25% of their income. Wiggins *et al.* (2002) found a similar result, only a small fraction of income came from agriculture in a case study of four *ejidos* in central Mexico in different climate regions with different agricultural crops; however, the majority (78%) practiced agriculture and it seemed to be predominantly for subsistence. Agriculture may still be a significant source of income for the 57% of the respondents in this study who received governmental assistance or those who were retired. Livestock was a common agricultural activity for many with 64.0% of the respondents owning cows, 33.9%

owning horses, 27.7% owning goats, and 25.9% owning donkeys and mules. Very few reported owning sheep, only 3.0% (figure 3). Livestock was used mainly for transportation and meat consumption as very little was earned from livestock. Respondents were asked about the annual income derived from livestock, and 44% of the respondents indicated that they earned between 500 and 775 pesos per year approximately $41- 64.43 US dollars/year at the time of the survey. Nineteen percent of the respondents made between 775-2,500 pesos per year (64.43-207.84 US dollars a year) and 17% earned between 2,500-4,500 pesos per year (207.84-374.11 US dollars a year) (Figure 4). The majority of respondents (67%) did not have fencing to exclude grazing from different owners. However, 69.4% of respondents stated that they used natural boundaries to exclude grazing from different owners (Figure 5). This area was historically a goat herding area; however, much of this has changed with meat consumption preferences of beef and government supported programs that pay mothers to keep their children in school, reducing the number of children available for herding. Thus, when respondents were asked if their sales of livestock had increased, decreased, or stayed the same over the past ten years the majority of respondents, 79.91%, stated that it had decreased and only 3% reported that it had increased (Table 2). Almost all respondents replied that they grazed their animals in the communal area (90.9 %). Only 29.3% of respondents stated that they cut, dried, and stored hay, therefore a low percentage of respondents used this as a resilience mechanism in the face of drought. Thus, many communities forced members to sell animals during droughts; 42.1% stated that they were forced to sell animals in the case of drought. General patterns emerging

from a historical analysis suggest that drought impacts are frequent and often severe especially in northern Mexico (Liverman, 1999).

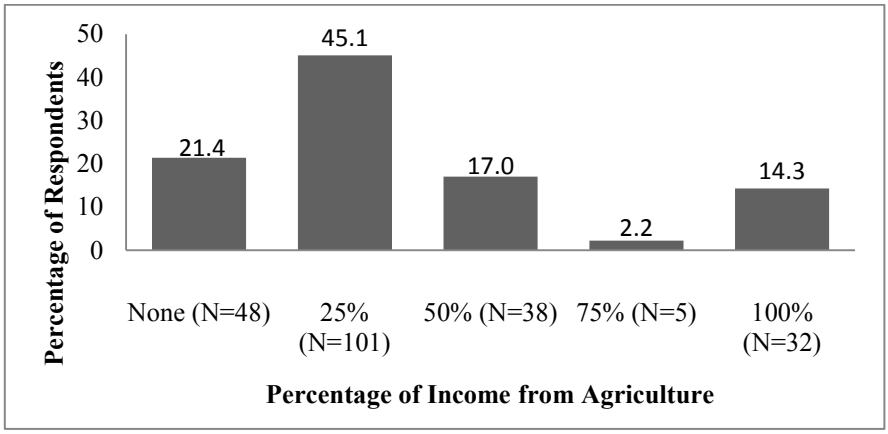


Figure 2. Percentage of Income Derived from Agriculture. Each column represents the percentage of respondents that reported the share that agriculture income has in their home. The number of respondents is listed next to the percentage share of income.

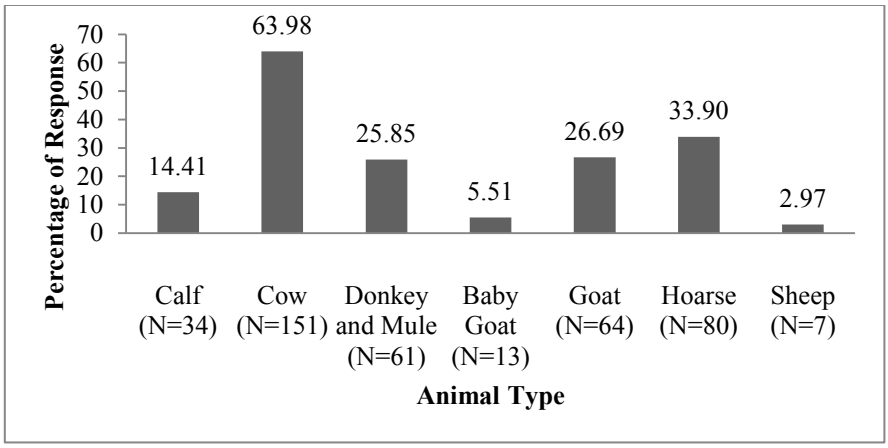


Figure 3. Type of Animals Owned. Each column represents the percentage of respondents that own different types of animals.

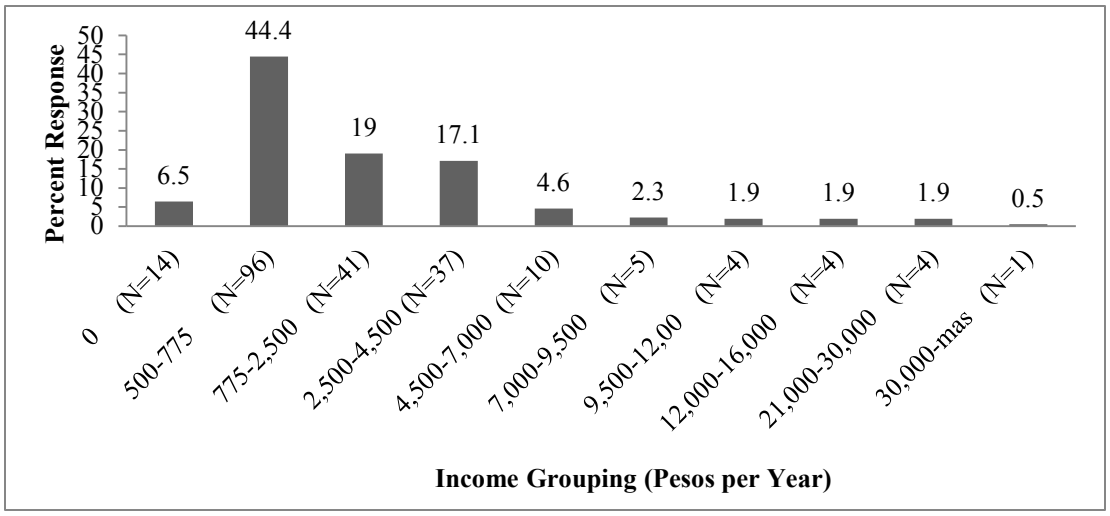


Figure 4. Pesos Earned per Year from the Sale of Livestock. Each column represents the percentage of respondents that pertain to the each listed income group range.

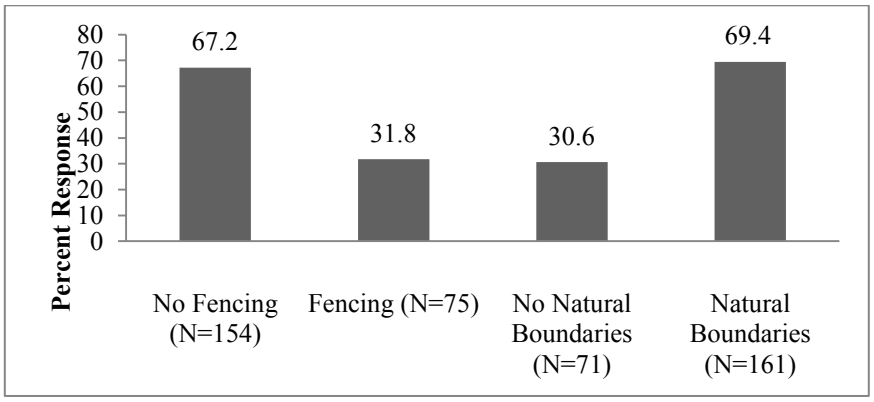


Figure 5. Pasture Fencing. Each column represents the percentage response of the type of fencing used to for grazing animals.

Table 2. Livestock Management Characteristics

Sale of livestock increase or decrease over the last 10 years		**Hay cut dried and stored**	
Decreased (N=189)	79.91	No (N=162)	70.7
Staid the Same (N=39)	17.03	Yes (N=67)	29.3
Increased (N=7)	3.05		
Graze in communal area		**Forced Selling of Animals**	
No (N=21)	9.1	No (N=132)	57.89
Yes (N=211)	90.9	Yes (N=96)	42.1

Agriculture Business Profile

It was apparent that a few communities had successful agro-businesses and collaborations that helped them sell to external markets; however, that experience seemed to be limited. Respondents were asked if there were groups in the community that had been successful in marketing products or providing benefits at a discounted rate; only 13% stated yes. Only 16.9% stated that resources in the community are pooled together for sale (Table 3). By having larger volumes of commodities farmers can achieve better pricing in external markets that require larger minimum sale volumes. Microfinance groups are also not common in the community as only 11% of respondents stated that there were any. Individual parcels are seldom rented to external livestock owners as only 15% of respondents answered the question in the affirmative.

Table 3. Agribusiness Statistics

Cooperative Success		Pooling for Sale		Microfinance		Land Rented to External Livestock Owners	
No (N=187)	87	No (N=192)	83.1	No (N=205)	88.4	No (N=198)	85.0
Yes (N=28)	13	Yes (N=39)	16.9	Yes (N=27)	11.6	Yes (N=35)	15.0

Community Characteristics

In general the communities seemed to have many desirable characteristics. The majority (83.8%) of respondents felt that the natural resource monitors did their job responsibly and that most of the community leaders had prior leadership experience (65.4% of respondents said so). A high percentage (75.6%) of respondents agreed that their community was always or usually managed in a transparent way. Almost a quarter of respondents, 24.5%, stated that their community is sometimes or never managed in a transparent way (Figure 6). The majority of the communities in this study are small in size as 79.9% of the respondents stated that they have less than 100 members. Baland & Platteau (1998) and Wade (1988 & 1994) have stated that the size of communities is important and that smaller communities are apt to have greater success. In this study, the size of the communities is generally small; with 80.3% of the respondents stating that their communities had ≤ 100 people. Communities between 100-250 people comprised of 8% of the respondents, as well as communities between 500-700 people. The distribution of the responses can be seen in Figure 7. Supposedly, parcels can only be

sold in *ejidos* to external members; however, a few respondents from *comunidades* stated that parcels in their community were sold although it was illegal. Since in general *comunidades* are not supposed to have parcels sold in the community only 177 respondents answered the question. The majority (80.2%) of respondents stated that parcels had not been sold in their community. The distribution of responses can be found in Figure 8. Only 8.4% said that between 1-3 individual parcels had been sold in their community. Another 6.8% respondents stated that between 4 and 10 parcels had been sold to external people. Very few respondents stated that over 10 parcels had been sold.

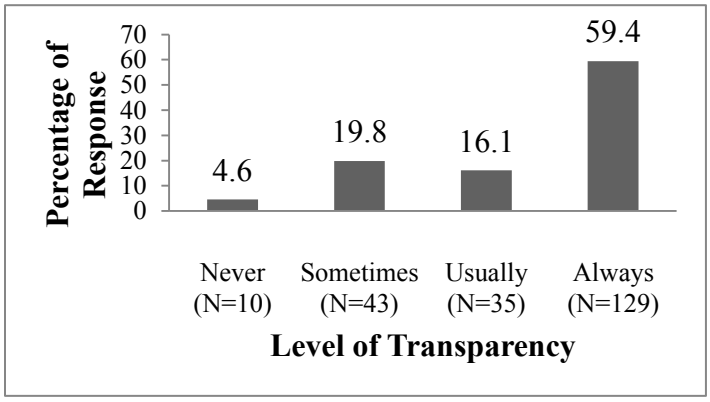


Figure 6. Community Transparency. Each column represents the percentage of response for the different transparency levels reported from the survey. Under each response category the number of respondents is reported. On top of each column lists the percentage of respondents.

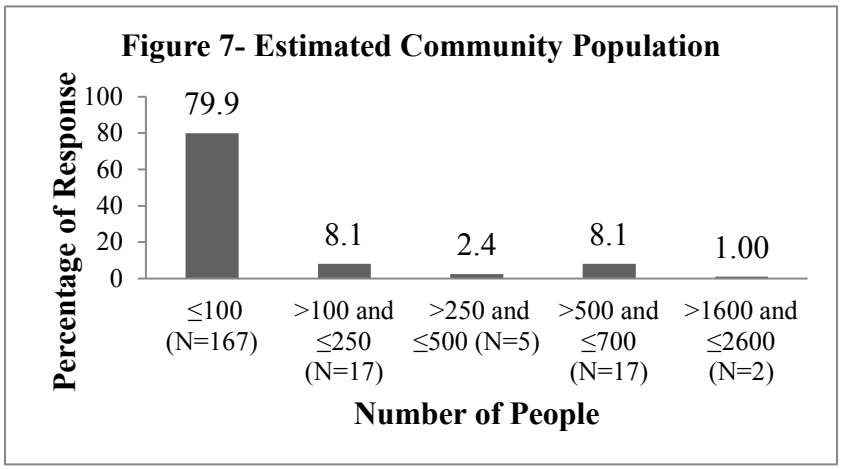


Figure 7. Estimated Community Population. Each column represents a range of people that exist in the community reported from surveys. The number for respondents is listed underneath the range. On top of each column the percentage of respondents is listed.

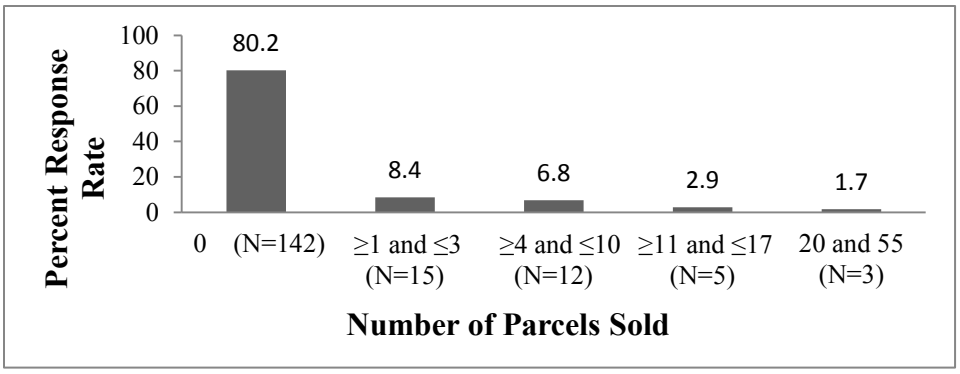


Figure 8. Parcels Sold Externally. Each bar represents the percentage of respondents that reported within a range of the number of land parcels sold externally in the community. Underneath each range of parcels sold externally lists the number of respondents. On top of each bar lists the percentage of respondents.

External Government Relationships

The majority of respondents (94.0%) stated that other governmental authorities respect local decision-making (Table 4). Apparently, external governments were involved in local enforcement of rules since 64% of respondents stated that other governmental or park authorities sanction bad natural resource management. However,

only 54% stated that other governmental authorities respected local punishment, only 10.3% stated that they did not support local decisions, and 35.4% stated that external governments are not involved in local decisions. It was assumed that there was less external government involvement in communities that were difficult to reach.

Table 4. External Government Relationships

Other Governmental Authorities Respect Local Decisions	**Other Governmental or Park Authorities Sanction Bad Natural Resource Management**
No (N=14) 6.0%	No (N=82) 36.0%
Yes (N=219) 94.0%	Yes (N=146) 64.0%
Other Governmental Authorities Respect Local Punishments	
No (N=23) 10.3%	
Gov Not Involved (N=79) 35.4%	
Yes (N=121) 54.3%	

4.2 Logit Regression Results

In total, four logistic regression models were constructed and estimated. One analysis was conducted to understand how effectively conservation is being promoted amongst communities in the park and what variables influence conservation promotion. A second was conducted to understand factors that affect overharvesting and overgrazing in these communities. Lastly, an analysis was conducted to assess how well users follow rules and how well users trust members to follow the rules. Backward conditional analysis was used to eliminate variables that did not hold a significant relationship using SAS statistical software. Many variables were eliminated and a suitable basis for developing the models was achieved. Table 5 lists the survey

Table 5. Variable Descriptions and Measurements

Qstn #	Variable Name	Description	Response Key
2	Com_Ejid	Are you a member of a communal land or *ejido*?	(0=Communal 1=both 2=Ejido)
5	gzhaprm	How many hectares are you allowed to graze?	(number)
7	past_bnd	How clear are the boundaries in which members are allowed to graze?	(1=very clear 2=clear 3=slightly clear 4=not clear)
15	groups	Are there any groups or organizations that exist within this community?	(0=No 1=Yes)
21	cm_trnsp	Is the commuity managed in a transparent way?	(1=Never2=Sometimes 3=Usually 4=Always)
26	microfin	Are there any groups that participate in microfinance in the community?	(0=No 1=Yes)
30	pstr_fnc	Are fences used to exclude grazing from different livestock owners?	(0=No 1=Yes)
31	pstr_ntbn	Are there natural boundaries (such as streams) that are used to exclude grazing from different livestock owners?	(0=No 1=Yes)
32	pst_rot	Does this community practice rotational grazing?	(0=No 1=Yes)
40	gov_pun	Do other governmental or park authorities sanction bad natural resource management or rule breaking?	(0=No 1=Yes)
41	cnsv_cmp	Do community members receive compensation for conservation activities?	(0=No 1=Yes)
42	gv_assis	Is any member of your family enrolled in a government program that assists you financially in any way?	(0=No 1=Yes)
47	overgraz	Do you think that pasture is overstocked with animals or overgrazed by community members?	(0=No 1=Yes)
48	overharv	Do you think that other resources are over harvested or that the demand is too high?	(0=No 1=Yes)
51	Rcom_made	Are management rules within the community created by members of this community/	(0=No 1=Yes)
53	RuleB_pn	Are rule breakers punished?	(0=No 1=Yes)
55	Foll_rul	How well do you trust other community members to follow the established rules?	(1=Never 2=Sometimes 3=Usually 4=Always)
56	Cmnc_NtR	How often do you communicate with other community members about resource management?	(1=Every few months 2=Monthly 3=Weekly 4=Daily)
57	prop_sld	If you are a member of an *ejido*, how many parcels have been sold to people outside the community?	(number)
61	Park_cnsv	How has the establishment of the park affected your natural resource management practices?	(1=toward less conservation 2=no impact 3= toward more conservation)
63	train_timeP	Has anyone come to your community to offer a training? If so, how frequently do they come?	(0=never 1=yes)

questions and the codes for all the variables that were used in the regression models, including the question number, a variable description, and a key explaining how responses were coded. The models were validated using several statistical tests including the Chi-Square Score test for the Proportional Odds Assumption (for ordinal models), the Hosemer Lemeshow Goodness of Fit test (for binary models), the Wald test for significance, and the log likelihood test for overall fit.

4.2.1 Park Impact on Conservation

The establishment of the park has affected the natural resource management practices of *ejidos* and *comunidades* that reside within or have boundaries inside the park. When asked how the establishment of the park has affected member's natural resource management practices, 14.7% stated-toward less conservation, 43.6% stated-no impact, and 41.8% stated toward more conservation. Park conservation was logistically regressed on compensation, pasture rotation, pasture boundaries, number of trainings received in a year, and the frequency of communication with other members about natural resource management. A few variables in the survey were significantly related to these responses (Table 6) and merit further review to understand how park promoted conservation can be improved.

Table 6. Park Conservation Ordinal Logit Regression Results

Dependent	Independent					
Prk_cnsv	(cnsv_cmp, Pst_rot, cmnc_NtR, Past_bnd, Trn_t_Yr)					
Variable	**Code**	**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr>ChiSq**
Intercept	1	1	-0.431	0.3973	1.1765	0.2781
Intercept	2	1	2.0943	0.429	23.8325	<.0001
cnsv_cmp	1	1	-1.0011	0.4265	5.509	0.0189
Pst_rot	1	1	-0.9179	0.3935	5.4425	0.0197
cmnc_NtR	2	1	-0.3736	0.3725	1.0058	0.3159
cmnc_NtR	3	1	-0.5796	0.4098	1.9998	0.1573
cmnc_NtR	4	1	-0.3486	0.4152	0.705	0.4011
Past_bnd	2	1	-1.1274	0.3907	8.3288	0.0039
Past_bnd	3	1	-1.1568	0.5118	5.1084	0.0238
Past_bnd	4	1	-0.8069	0.6707	1.4472	0.229
Trn_t_Yr		1	-0.231	0.1271	3.3024	0.0692
	Cases Included in Analysis			N=194 (82.6%)		
	-2 Log Likelihood			384.896		
	Correct Model Prediction Percentage			66.5		

Compensation

Only 13.4% of respondents stated that community members received compensation. Respondents that stated that members in their community received compensation were less likely to think that the park has improved their conservation practices when compared to respondents who had not received compensation, with a *p*-value of 0.0189 and an estimated coefficient of -1.0011. A one unit increase in compensation going from 0 to 1 (no compensation-0 to compensation-1) had an expected -1.0011 decrease in the log odds of being in a higher level of park conservation, given all the other variables in the model are held constant. Members who

had received compensation generally received it for labor affiliated with assisting with stopping forest fires, planting seedlings, or maintaining nurseries. Lindberg *et al*. (1996) associated negative attitudes of park residents with perceptions of not receiving a fair share of the benefits. Several authors propose inclusion of communities in the designation process and decision making related to compensation. Overlooking this can further hamper the implementation of conservation goals (Li & Liu, 2010; Abakerli, 2001; Frauman & Banks, 2011).

Pasture Rotation

Only 10.6% of the respondents stated that they practiced rotational grazing, thus it is not a widely adapted practice in these communities. Rotational grazing is loosely defined here as people that move their animals from one area to the next. Only a loose definition could be used since so few people practiced this. Those that stated that they practiced rotational grazing were more likely to state the park had lessened their conservation practices ($p = 0.0197$; regression coefficient = -0.9179). A one unit increase going from 0 to 1 (no rotation-0 to rotation-1), would see an expected 0.9179 decrease in the log odds of being in a higher level of park conservation, given all of the other variables in the model are held constant. Semi-nomadic and nomadic pastoralists are citied as often times having rich conservation knowledge (Stave *et al.*, 2007; Goldman, 2003; Fernandez-Gimenez, 2000). It is possible that those who rotated their animals for grazing had a superior conservation knowledge as shown in Stave *et al.*(2007) when he compared the ecological knowledge of semi-nomadic to sedentary pastoralists. While those who rotate their animals are not nomadic they are more mobile

than the other herders in the study area. Different resource users and income groups can have different tendencies to support conservation measures (Mehta & Kellert, 1998; Natura, 1995). It is evident here that those who rotate their animals were less likely to think the park had improved their conservation practices. Park promoted conservation or park acceptance amongst this group may be more difficult to achieve.

Pasture Boundaries

Wade (1988 & 1994) and Ostrom (1990) specified the importance of the clarity of boundaries for communal land management success. Boundary clarity is also mentioned in conservation literature; unclear boundaries are seen as a threat to conservation that can lead to conflict (Wunder *et al.*, 2008; Yasmi *et al.*, 2007; Mugisha *et al.*, 2004). When respondents were asked "How clear are the boundaries in which members are allowed to graze," 16.6% responded "very clear," 64.3% responded "clear," 13.2% responded "slightly clear," and 6% responded "not clear." Respondents that selected "clear" were less likely to think the park has positively influenced their conservation practices compared to those that stated "very clear" ($p = 0.0039$; regression coefficient = -1.1274). A one unit increase in boundary clarity going from the base of 1 (very clear) to 2 (clear) would expect to see a 1.1274 decrease in the log odds of being in a higher park conservation category, given all of the other variables in the model are held constant. Respondents that selected "slightly clear" were less likely to think that the park had positively influenced their conservation practices compared to those that selected "very clear," with a p value of 0.0238 and an estimated regression coefficient of -1.1568. An increase in pasture boundary clarity going from 0 (very clear) to 3 (slightly

clear) would expect to see a 1.1568 decrease in the log odds of being in a higher park conservation category, given all of the other variables in the model are held constant. Those that answered "not clear" did not hold a significant relationship with park promoted conservation practices. The park had a more positive impact in communities where boundaries were very clear. It is possible that respondents that stated "very clear" have received clarification from external government authorities. Efforts to clarify boundaries amongst community members who had "slightly clear" and "clear" property boundaries could improve conservation promotion amongst park communal land inhabitants. Since only 16.6% of respondents selected "very clear" and 77.5% of respondents selected "clear" and "slightly clear," additional clarification could have substantial benefits by preventing users from grazing outside of the community boundary further promoting plant regeneration in the buffer areas around human settlements.

Training Times per Year

Trainings are a common method to promote conservation amongst natural resource users. However, trainings can have varied success rates in promoting conservation and adaptation (Deressa *et al.*, 2009; Mehta & Kellert, 1998; Fujisaka, 1993). Trainings were often mentioned in the field, and to understand its effect on conservation promotion it was included in this study. Multiple conservation actors (SEMARNAP, CONANP, and local NGOs) and governmental actors (municipal and government assistance agencies) were stated to have given trainings in these communities. However, the vast majority of the respondents could not recall from

whom they had received training. Figure 9 shows a distribution of responses regarding the frequency of trainings received in the last year. The majority of respondents (67.8%) stated that they have not received training in the last year, and 32.2% stated that they did receive one or more trainings in the last year. Respondents who received more trainings were less likely to state that the park had improved the respondents conservation practices with a p= 0.0692 and an estimated regression coefficient of 0.231. This variable was not significant at the 95% confidence level and thus there is no need to be interpreted further.

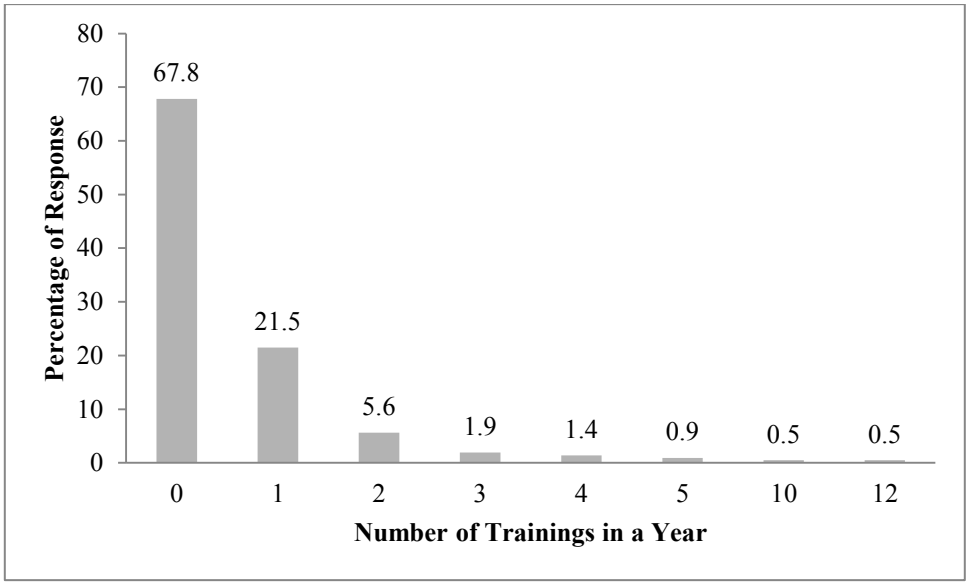


Figure 9. Number of Trainings Received in the Last Year. Each column represents number of trainings attended in a year. The percentage of respondents that attended each training frequency is listed at the top of the bar graph.

The Frequency of Communication about Natural Resource Management

Communication frequency around natural resource management was included in the logistic regression model due to its possible influence on trustworthiness and fairness with the park. In a study conducted amongst trustee's and tustors the level of perceived trustworthiness was effected by the frequency of communication (Becerra & Gupta, 2003). The frequency of communication about natural resource management could also influence the respondents trustworthiness of the park. In a study examining the complex relationships between superiors and subordinates fairness perceptions were found to often be constructed by workgroup members through discourse (Sias & Jablin, 1995). Thus, increased communication frequency could influence how the park either promotes or discourages conservation practices by increasing trust and fairness perceptions. Baland & Platteau (1996), and Wade (1988 & 1994) stated that interdependence among members and ease of enforcement of rules are important for successful communal land management. To inquire about this relationship further, questions were asked of the respondents about the frequency of communication regarding natural resource management among communal members to determine its importance. However, it did not have a significant relationship with park promoted conservation practices in this case study. Perhaps members are not talking often about the park when discussing natural resource management.

Summary

Conservation norms are not easily introduced into a community through external actors. Little is known about what strategies successfully alter the norms people hold

about conservation, particularly when the resources in question are relied upon for subsistence (Agrawal & Gibson, 1999). Conservation promotion acceptance may also vary between groups (Mehta & Kellert, 1998; Natura, 1995). Respondents who stated that members in their community has received compensation for conservation were less likely to state that the park has improved the~~ir~~ respondents conservation practices. Including communities in the decision making on conservation could potentially improve this relationship further. Respondents who practice rotational grazing were less likely to state that the park has improved their conservation practices. Promoting conservation amongst this group may be more difficult and could use further research and inquiry. Respondents, who stated that pasture boundaries are "very clear," were more likely to think that the park has improved their conservation practices compared to respondents who stated "clear" or "slightly clear". Communal lands could further promote conservation by clarifying boundaries amongst all communal members. The number of trainings received in the last year and the frequency of communication about natural resource management amongst communal members was not significant. One pertinent finding while conducting household surveys is that multiple government actors have come to the area to give trainings and often times the respondents cannot recall what agency they are associated with and lump other actors together with the park. It is pertinent that the park further knows who is conducting trainings and what is being covered, as it appears that these trainings are also influencing resident's perceptions of the park.

4.2.2 Overgrazing and Overharvesting

Baland & Platteau (1996), Wade (1998 & 1994), and Ostrom (1990) mentioned that communal institutional characteristics could lead to ecological sustainability. In an effort to quantify sustainability, questions regarding overgrazing and overharvesting were tested. Respondents were asked, "Do you think that pasture is overstocked with animals or overgrazed by community members?" Respondents are only allowed to graze in their communal grazing area or individual parcel. Overgrazing in this question specifically refers to the respondents community and was implied in the question. There are multiple herders in these communities and only animal owners were interviewed. Thus the results are based on perceptions, not physical quantities. It should be noted that perceptions may vary. Respondents were also asked, "Do you think that other resources are over harvested or that the demand is too high?". This was followed by an open-ended question regarding what other resources they were refereeing to. Seventeen open-ended responses were received. Seven of the respondents referred to wood and trees. Six respondents referred to fruit such as peaches, pears, apples, plums, quince, or wine grapes. Two respondents referred to water, mountain range, and wheat and corn. One respondent referred to soil, and another respondent refereed to herbs that grow wild in the area. Thus, the resources are varied but the highest response was with wood and trees. Cutting of live wood was sanctioned by SEMERNAP and the park (CONANP). The dependent variables (overharvesting and overgrazing) were then linearly regressed with independent variables regarding communal institutional characteristics. Interestingly, there were different institutional characteristics that were significantly

related to the presence and absence of overharvesting and overgrazing. It is apparent that different resources have different governing relationships.

Overgrazing

Little is known about what institutional characteristics lead to overgrazing in *ejidos* and *comunidades*. Overgrazing in Mexican *ejidos* has been characterized as a result of property management deterioration (Wilson & Thompson, 1993). *Ejidos* have also been cited to have more native vegetation and have also been shown to be just as productive as private lands (Coronado-Quintana *et al.*, 2001). To understand what institutional characteristics are associated with the absence and presence of overgrazing, a binary logit model was estimated (Table 7) with the following independent variables: government assistance, organizational structure type (*ejido* or *comunidad*), external government punishment for bad natural resource management, park promoted conservation, and hectares permitted for grazing.

Table 7. Binary Logit Regression for Overgrazing

Dependent	Independent					
Overgraze	(Gv_assis, com_Ejid, gov_pun, Prk_cnsv, gz_haprm)					
Variable	**Code**	**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr>ChiSq**
Intercept		1	-2.9438	1.1603	6.4365	0.0112
Gv_assis	1	1	1.1007	0.482	5.2138	0.0224
com_Ejid	0	1	3.0260	1.1924	6.4406	0.0112
com_Ejid	1	1	3.8710	1.1048	12.2761	0.0005
gov_pun	1	1	-1.4549	0.4972	8.5637	0.0034
Prk_cnsv	2	1	-2.2493	0.8168	7.5828	0.0059
Prk_cnsv	3		-0.6589	0.7283	0.8186	0.3656
gz_haprm	3	1	0.000178	0.000068	6.8268	0.009
	Cases Included in Analysis			N=151 (64.3%)		
	-2 Log Likelihood			185.652		
	Correct Model Prediction Percentage			87		

Hectares Permitted for Grazing

When respondents were asked how many hectares they were allowed to graze in their community, 68 different values were reported with a range from 0-11600 hectares. Hectares that are allowed for grazing refer to the communal grazing area for the respondents community. When the responses were grouped, 56% of the respondents stated that they had between 0-100 hectares permitted for grazing, 16.5% between 125-500 hectares, 13.2%between 600-2,500 hectares, and 14.3% between 2,965-11,600 hectares permitted for grazing. The land size of the communal resource base has been a proxy for communal land management since the beginning of the subject. While many authors and researchers suggest that small communities are better for successful natural resource management, there are small communities that have unsuccessful management and nomadic groups that manage large areas successfully (Agrawal & Gibson, 1999).

The size for the resource base was included to determine its level of importance in this area. For every one hectare increase respondents were more likely to state that there is overgrazing, with a p value of 0.0009 and an estimated regression coefficient of 0.000178. A one unit increase in hectares permitted to be grazed would expect a 0.000178 increase in the log odds of being in a higher level of overgrazing, given all of the other variables in the model are held constant. This can have a larger impact over hundreds and thousands of hectares. There may be several factors influencing this relationship. The areas that are being mentioned here is the communal grazing area where permits are not needed. Permits are only for harvesting trees. Larger areas are harder to monitor and/or the rebound effect. The rebound effect refers to how the quantity demanded of a good increases as its price declines. In this case, as there is more area at a lesser cost, there is more overgrazing. This effect is also apparent in transportation. Transportation researchers have long recognized that any changes that reduce congestion will cause travel on the congested facility to increase. This is assuming the absence of an offsetting deterrent (Thomson, 1967; Smeed, 1968; Downs, 1962). To provide an offsetting deterrent for overgrazing in larger areas, multiple monitors and systematic livestock rotation could be helpful in reducing overgrazing.

Ejidos and Comunidades

Respondents could be from three organizational arrangements: *ejidos, comunidades,* or both. *Ejidos* had larger populations in general and comprised of 59.9% of the respondents, *comunidades* were 24.2% of the respondents, and 15.3% of the respondents were from both. When *comunidades* were compared to the base of *ejido,*

comunidades were 19.61 times more likely to state there is overgrazing in their community, with a p values of 0.0112. When both were compared to the base of *ejido,* both were 46.99 times more likely to state there is overgrazing in their community, with a p values of 0.0005. *Comunidades* in general were smaller and it seemed that many of their members are related. All members in the community seemed to have equal rights to the grazing areas and ability to attend meetings. In *ejidos,* if the son had not received a land title from his deceased father, he could be restricted from grazing his own animals in the communal area since he was not an *ejido* member. In a *comunidad,* on the other hand, the sons grazing is still allowed and cannot be contested. In the *ejidos* only one male family member attends communal meetings. Meeting attendance appeared to be more flexible in the *comunidades*. Thus, it was included in the analysis to determine if one organizational structure is more susceptible to overgrazing than the other. Only one community, *Laguna de Sanchez,* reported having both, and they have the largest human settlement in the park. This result of both may reflect the high population density in *Laguna de Sanchez* rather than differences in the organizational structures.

Government Punishment

The majority of the respondents (64.8%) stated that other governmental or park authorities fined bad natural resource management or rule breaking, and 35.2% stated that they did not. Respondents that stated the government sanctioned bad natural resource management were less likely to state that there is overgrazing, with a p value of 0.0034 and an estimated regression coefficient of -1.454. A one unit increase in government punishment going from 0 (no government punishment) to 1 (government

punishment) would expect a decrease of 1.454 in the log odds of being in a higher level of overgrazing, given all of the other variables in the model are held constant. When looking at how enforcement and compliance differs with the levels of government in a federal system, the literature is scarce and the results are ambiguous (Cohen, 1998). Conservation gains in reducing the hunting of large animals in Kenya, Zimbabwe, and Zambia, often on communal lands, appear to have come from enforcement and not from local acceptance of conservation (Gibson, 1999). Ostrom & Nagendra (2006) and Agrawal & Gibson (1999) support a system of checks and balances for communal lands that involves external government enforcement. External enforcement has shown to be effective in reducing the perception of overgrazing in this case study. However continued support for local punishment is important to not replace local rule enforcement. When respondents were asked, "Do other governmental authorities and institutions support local punishments for rule breakers?" 10.7% stated no, 35.7% -stated that external governments are not involved, and 53.6% stated yes. External government appears to be generally supportive or not involved regarding local rule enforcement. The majority of respondents (88.9%) thought that pasture usage was regulated in a fair manner for all members. A fair perception of pasture rules coupled with external enforcement has resulted in a decreased perception of overgrazing.

Park Conservation

When respondents were asked, "How has the establishment of the park affected your natural resource management practices," 14.7% stated "toward less conservation," 43.6% stated "no impact," and 41.8% stated "toward more conservation." The

respondents who said the park had no impact on their conservation practice were less likely to perceive overgrazing on their communal pastureland when compared with those who said the park had led to less conservation of their communal natural resources, with a p-value of 0.0059 and an estimated regression coefficient of -2.2493. A one unit increase in park conservation going from 1 (less conservation) to 2 (no impact) would expect a 2.2493 decrease in the log odds of being in a higher level of overgrazing, given all of the other variables in the model are held constant. Responses of "toward more conservation" did not hold a significant relationship. It is possible that those that stated that there is more conservation were thinking of other resources instead of just pastureland.

Summary

Several key factors were discovered that influence the relationship between overgrazing and institutional factors. Recipients of government assistance were more likely to report that there is overgrazing. While current compensation schemes are not successful in promoting conservation some adaptations could enable a compensation scheme that could reduce overgrazing amongst government assistance recipients. Compensation schemes would have to grouped with rules on conservation practices and have external enforcement to be successful. If participation in such a program is voluntary and compensation meets or exceeds their current financial gain in overharvesting it is assumed that compliance would be the norm due to the financial benefit. Respondents that stated they had larger grazing areas were more likely to state that there is overgrazing. To provide an offsetting deterrent for overgrazing in larger

areas, multiple monitors and systematic livestock rotation could be helpful in reducing overgrazing. When comparing institutional arrangements the mixed system in *Laguna de Sanchez* was significantly more likely to state that there is overgrazing when compared to *ejidos*. *Comunidades* were also more likely to state there is overgrazing when compared to *ejidos*. The defined organizational structure of *ejidos* with limited benefits to one member per household is possibly reducing grazing pressure. Many *comunidades* mentioned the desire to transition to an *ejido* structure through PROCEDE. The park may help expedite their application with PROCEDE to potentially reduce overgrazing in *comunidades*. Further research is needed to determine potential benefits or costs to the organizational structures (*ejido, comunidad*, and both). Respondents who selected that external government authorities sanction bad natural resource management were less likely to state that there is overgrazing. Pasture regulations were generally perceived to be fair. Law enforcements by external governmental authorities appear helpful in reducing overgrazing and thus should be continued.

Overharvesting

Ejidos and *comunidades* have been shown to have higher conservation habitat than private lands (Ortega-Huerta & Kral, 2007). *Ejidos* have been cited to promote conservation by preserving forests (Sánchez-Azofeifa *et al.*, 2009; Ellis & Porter-Bolland, 2008), birds, and mammal species (Ortega-Huerta & Kral, 2007). Deforestation in *ejidos* has also been linked to corn prices and poverty (Deininger & Minten, 1999). Other studies link deforestation with corn yield and the access to markets (Perez-Verdin *et al,*. 2009). Many important factors are at play in these

relationships. To further understand the presence and absence of overharvesting in the communal lands inside the *Cumbres de Monterrey* National Park, the presence of overgrazing is logistically regressed on: microfinance, the presence of other organized human groups, pasture fencing and natural boundaries to exclude grazing, external government punishment for bad resource use, and the number of properties sold to external buyers. This model was run separately and with different indicators from the overgrazing model. Results are displayed in Table 8. Overgrazing and overharvesting held different significant relationships with external government punishment, and users have different perceptions of ownership over these resources.

Table 8. Binary Logit Regression Results of Overharvesting

Dependent	Independent					
Overhav	(microfin, pst_Ntbn, Gov_pun, groups, pstr_fnc, Prp_sld)					
Variable	**Code**	**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr>ChiSq**
Intercept		1	-6.2899	1.8047	12.1467	0.0005
Microfin	1	1	1.7901	0.7385	5.8757	0.0154
pst_Ntbn	1	1	-3.4448	1.5041	5.245	0.022
Gov_pun	1	1	4.0562	1.5983	6.4408	0.0112
Groups		1	1.1314	0.6963	2.6404	0.1042
pstr_fnc	1	1	2.7603	1.5277	3.2646	0.0708
Prp_sld		1	0.1104	0.0453	5.9391	0.0148
	Cases Included in Analysis			N=159 (67.7%)		
	-2 Log Likelihood			99.364		
	Correct Model Prediction Percentage			92.6		

Microfinance

Only 11.5% of respondents stated that there were groups in their community that practiced microfinance. Respondents who stated that there were microfinance groups in their community were 56.75 times more likely to state that there is overharvesting in their community than those who did not participate in microfinance, with a p value of 0.0154. It is possible that some groups that have access to microfinance are utilizing funds to buy equipment that contributes to overharvesting. Many but not all microfinance institutions report on environmental sustainability (Rippey, 2012). Amongst microfinance institutions that report on environmental sustainability there is not, a sole adapted methodology to measure this (Allet, 2012). Jetti (2011) argues that microfinance is linked to the commons since, "a majority of the loan recipients of microfinance loans in the developing world make at least a part of their living by utilizing common pool resources (CPR) such as forests, fisheries, agricultural lands, mineral resources, waterways and the like." Research in this area has proven to be difficult, as many micro lenders do not keep documentation of what the loan was used for (Goldsworthy, 2010). Communities and governmental conservation agencies should maintain vigilant on natural resource use where microfinance groups are located. It is important to understand what these loans are about and to monitor for what purpose they are being used.

Pasture Natural Boundaries and Fencing

When respondents were asked if there was fencing to exclude grazing, 67.2% of the respondents stated that fencing was not used and 21.8% of respondents stated that

fencing was used. When asked if natural boundaries were used to exclude grazing, 30.6% stated that natural boundaries were not used and 69.4% stated that natural boundaries were used to exclude grazing. Figure 2 shows a visual depiction of this data. Natural boundaries are the prevalent norm for livestock grazing exclusion. Due to the high rate of governmental assistance received in the park, fences may be too expensive for many of the respondents. Respondents who selected that natural boundaries were used were less likely to select that there was overharvesting in their communities, with a p value of 0.022 and an estimated regression coefficient of -3.44. A one unit increase in natural boundaries going from 0 (no natural boundaries) to 1 (natural boundaries) would expect a 3.44 decrease in the log odds of being in a higher level of overharvesting, given all of the other variables in the model are held constant. Respondents who selected that fences were used were 14.804 times more likely, given the positive coefficient, to state that there was overharvesting, however, this cannot be interpreted at the 95% confidence level since a p value is 0.0708. This could be an indication that the terrain in the natural boundary areas promotes forests instead of pasture. Further research is needed.

Property Sold

The majority of respondents (80.2%) stated that parcels of these lands were not sold externally. For those who stated that parcels were sold externally, between 1-55 parcels were reported. Responses were grouped, figure seven shows a distribution of the data; 8.4% stated that between 1-3 parcels were sold externally, 6.8% stated that between 4-10 parcels were sold externally, 2.9% stated that between 11-17 parcels were sold externally, and only 1.7% stated that between 20-55 parcels were sold externally.

The sale of the communal area in forested *ejidos* is illegal (Barsimantov *et al.*, 2009). The laws passed in 1992 established a legal market for the sale of *ejido* land that replaced an illegal market that is widely acknowledged to exist (Matson, 2012). *Comunidades* were also included in this analysis since there were reported illegal sales in *comunidades* while in the park. Selling properties in *comunidades* is not legal; however, land can be sold after registering the *comunidad* as an *ejido*. *Comunidades* were included in the analysis since illegal sales in *comunidades* were mentioned while in the field. With each parcel increment sold externally, respondents are 1.116 times more likely to state that there is overharvesting, with a p value of 0.0148. *Ejidos* and *comunidades* have been shown to have higher conservation habitat than private lands (Ortega-Huerta & Kral, 2007). It is likely that new owners have the resources to more intensively manage their land or performing landscaping that results in habitat reduction. Further research is needed to understand what types of overharvesting is occurring where there are external buyers.

Government Punishment

When respondents were asked if other government or park authorities sanction bad natural resource management or rule breaking, 64. 8% stated they did and 35.2% said that they did not. Respondents who stated there was external punishment were almost 57 times more likely to state there was overharvesting in their community than other respondents, with a p value of 0.0148. When respondents were asked if other agricultural harvesting besides range management was regulated in a fair manner for all members, 62.4% stated no and 37.6% stated yes. Regulations for overharvesting are

generally perceived to be unjust whereas overgrazing regulations were perceived as just, as described in the previous section. Due to the strength of this relationship it is apparent that the unjust perception of overharvesting regulations are causing more overharvesting when coupled with external government punishment. Users can result to retaliation by exploiting the given resource when there is a centralized authority that is regulating the use of natural resources that are deemed to be owned by the community (Drijver, 1991). Retaliation harvesting was not mentioned in the field. However, it was evident on the ground that there was resentment regarding the harvesting of trees, particularly from users who had applied for permits to cut green wood and had been denied. This resentment could be amplified if external parcel buyers are not being held to the same rules as communal members. SEMERNAT needs to re-evaluate the minimal permit allowances as they have potentially lost more trees from the rejection of these permits through retaliation cutting. Further inquiry into why there is more overharvesting with increases in external properties sold is also needed so that this resentment is not potentially amplified further.

Groups

It was originally thought that increased human organization could decrease overharvesting since institutions can serve as a safeguard for conservation (Agrawal & Gibson, 1999). However, the presence of groups in communities was not found to be significant with overharvesting.

Summary

Several important variables were found to influence the presence of overharvesting in communities in the park. Respondents who stated that there was a microfinance group in their community were 57 times more likely to state that there was overharvesting than other respondents. Increased vigilance on the use of natural resources where microfinance is occurring is suggested. Respondents who used natural boundaries to exclude grazing from different livestock owners were less likely to state that there is overharvesting. The absence of fences may have created a greater need to attend to animals and assure they are not damaging natural resources. Promoting fencing for livestock grazing may not have any benefits, as natural boundaries are associated with a decreased presence of overharvesting. Respondents who stated that properties were sold to external buyers were more likely to state there is overharvesting in their community as the number of parcels sold increased. It is pertinent that the park makes sure that external buyers are following natural resource rules to avoid resentment in the communities. Further research is needed to determine why there is more overharvesting when there are more external buyers. The presence of groups in communities was not found to be statistically significant with overharvesting. Respondents who stated there was external punishment were almost 57 times more likely to state there is overharvesting in their community. The majority of respondents (62.4%) thought that natural resource regulations other than pasture were not fair. External government punishment held an opposite relationship with overgrazing. The majority (88.9%) of the respondents perceived pasture regulation as fair and external

government punishment was related to reduced overgrazing. Thus, it was suspect that retaliation harvesting was occurring for resources other than pasture. The regulations of natural resources other than pasture need to be revisited, and sustainable harvest limits may need to be considered to reduce retaliation harvesting.

Compensation Potential

Mexico has a payment services program on select watersheds where there is not commercial forestry and where there is water scarcity in the region. Currently the payment program is funded by federal earmarked water taxes. Local funding was discarded in the first project round due to lack of immediate prospects. Thus the existence of a local payment for environmental services was made part of the applications grading system. To solve targeting issues of not getting to the poorest of the poor the system has added a weight in the application grading system to include poverty as well. The federal payment rate was fixed to M$300/ha ((US$27.3) annually and M$400/ha (US$36.4) for cloud forests (Muñoz-Piña *et al*., 2008). However Cumbres de Monterrey does not seem to be included presently in this federal program. As the federal government had identified this as an important criteria *Cumbres de Monterrey* could be a good location to try a local payment for environmental services.

An analysis of the implementation for a Hydrological Environmental Services mechanism in *Cumbres de Monttery* has been conducted with contingent valuation, cost of opportunity, and restoration costs. The research suggests that the society is conscious of the importance of the conservation of the area and a willingness to pay. The study reveals that households are willing to pay M$6.80 a month (USD $ 0.60) in the eight

municipalities around the park. Surface water proved 55% of the provision of water from the park and underground aquifers provide 45%. The underground aquifers have a deficit from overexploitation. The majority of the deforestation in the park has been a result of forest fires. The cost of restoration could be between $5,161 and $9,485 USD (Saldivar *et al.,* 2013). *Cumbres de Monterrey* could be a great pilot to try a locally funded payment for environmental services for areas that do not meet the federal governments present ranking criteria. Assistance for *comunidad* and *ejido* members that were not located near the main road and who did not received benefits from tourism or frequent park monitoring was pressing. Such a program could have improved conservation outcomes and benefits for communal members in the park. Such a program involves multiple government actors which could increase transaction costs. Since water is federally subsidized in Mexico perhaps action at the federal level could facilitate this further.

4.2.3 Trust to Follow the Rules

When respondents are asked "How well do you trust other community members to follow the established rules?", 57% selected "always," 13.7% selected "usually," 22.3% selected "sometimes," and 6.9% selected "never." The responses are skewed toward positive sentiments. Figure 10 shows a distribution of the responses. In a laboratory trust experiment .67 of the participants choose a mutually beneficial option, over .37 chose to act selfishly on their behalf and further gain more money. Furthermore, .67 of the players trust the other player to choose the mutually beneficial option and only .37 chose an option of self-protection from the other player's potentially

selfish choice (McCabe *et al.*, 2003). This finding is inconsistent with outcome-based models but predicted by the trust and reciprocity hypothesis (McCabe *et al.*, 2003), and is consistent with the distribution of responses found here. It is of concern that the few who act selfishly on their behalf may erode trust and deteriorate rule compliance. Institutions must continually uphold expectations to fight off the natural state of deterioration (Runge, 1981). This model explores factors that promote or deteriorate trust in communities to provide information that will assist in fighting off the natural state of deterioration of trust in rule compliance. Results are displayed in Table 9. Trust in community members is likely to influence not only the action of the individuals but also the compliance to rules at different institutional scales: local, park, and federal.

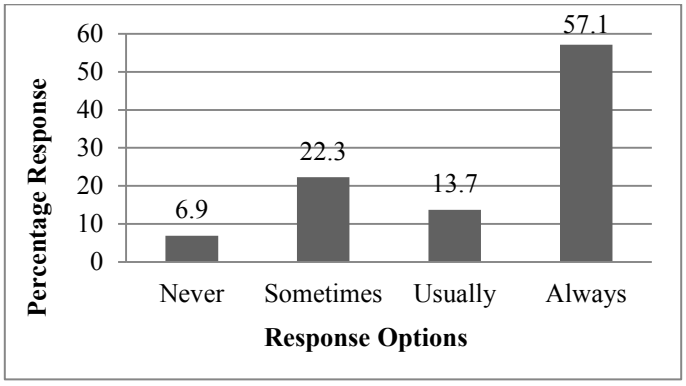


Figure 10. Trust for Other Community Members to Follow the Rules. Each column represents the category selected when respondents were asked how often they trusted other community members to follow the rules.

Table 9. Ordinal Logit Regression Results of Trust to Follow the Rules

Dependent	Independent					
Foll_rul	(cm_trsnp, gz_haprm, cmnc_NtR, Rcom_mad, RuleB_pn)					
Variable	**Code**	**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr>ChiSq**
Intercept	1	1	-0.0169	0.6966	0.0006	0.9807
Intercept	2	1	3.0327	0.7054	18.4843	<.0001
Intercept	3	1	4.0728	0.7408	30.2293	<.0001
cm_trnsp	1*	1	-2.2912	0.3775	36.8431	<.0001
gz_haprm		1	-0.00025	0.000089	8.0623	0.0045
cmnc_NtR	2	1	-0.9388	0.4945	3.6043	0.0576
cmnc_NtR	3	1	-1.3588	0.481	7.9808	0.0047
cmnc_NtR	4	1	-1.3891	0.5272	6.9413	0.0084
Rcom_mad	1	1	-1.4655	0.6043	5.8821	0.0153
RuleB_pn	1	1	-0.7278	0.362	4.0415	0.0444
	Cases Included in Analysis			N=157 (66.8%)		
	-2 Log Likelihood			345.453		
	Correct Model Prediction Percentage Correct			80.8		

*1, 2, and 3 were merged to 0, and 4 was changed to 1 for cm_trsnp. 4 was significant and the others were not in the prior model that would not pass the score test.

Transparency

Transparency was included in this study as a survey variable due to its reference in literature as an essential component of communal land management (Nelson & Agrawal, 2008; Blaikie, 2006; Child, 1996). When respondents were asked if the community was managed in a transparent way, 5% selected "never," 19.7% selected "sometimes," 16.1% selected "usually," and 59.2% selected "always." In the first model, "always" was the only significant response and the model did not pass the Score Test for the Proportional Odds Assumption. To get the model to pass the Score Test for the Proportional Odds Assumption, the three non-significant options were merged:

never, sometimes, and usually. The merged categories were changed to 0 and "always" was changed to 1. When respondents selected "always" they were less likely to state that they trusted members to follow the rules, with a p value of <0.0001 and an estimated regression coefficient of -2.2912. A one unit increase in transparency going from 0 (merged categories of less transparent) to 1 (always transparent) would expect to see a 2.2912 decrease in the log odds of being in a higher level of trust for members to follow the rules, given all of the other variables in the model are held constant. When full disclosure is on the table, people may be more aware of the rule breaking that is occurring or the tendency of blurring the lines a little, further causing one to trust people less to follow the rules. Frances Cleaver states:

> Transparency is a much advocated, but in my view, a much overrated requirement of institutional arrangements as many social relationships and transactions depend on a certain degree of blurring the rules, of looking the other way, ignoring contraventions of norms (Cleaver, 2002).

To build more trust among community members, communities that are always managed transparently should be managed with less full disclosure. A certain degree of disclosure is necessary; however, due to these results less frequent disclosure in completely transparent communities builds more trust. The degree to which this disclosure should take place and how transparency should be managed is unknown, and further research needs to be conducted. It is often assumed that transparency is an integral component of communal land management since it is a component of democracy. It is important to realize that democratic institutions do not have complete transparency. Thus, this notion

of transparency needs to be quantified and examined further to really understand what level of disclosure promotes trust in members following the rules as total disclosure has been found to reduce trust in this study. Further research in this area is important for conservation rule compliance as 59.2% of the respondents stated that their communities are "always" managed in a transparent manner.

Hectares Permitted for Grazing

How smaller areas affect trust in members to follow the rules in this locality is unknown. The aspect of size of the grazing area or the communal resource base is included in this model to understand the relationship further with trust to follow the rules. When respondents were asked how many hectares they were allowed to graze, 68 different values were reported with a range from 0-11600 hectares. When the responses are grouped, 56% of the respondents stated that they had between 0-100 hectares permitted for grazing, 16.5% stated that they had between 125-500 hectares, 13.2% stated they had between 600-2,500 hectares, and 14.3% stated they have between 2,965-11,600 hectares permitted for grazing. For every one-hectare increase, respondents were less likely to trust members to follow the rules, with a p-value of 0.0045 and an estimated coefficient of -0.00025. A one unit increase in the hectares permitted for grazing would expect to see a 0.00025 decrease in the log odds of being in a higher level of trust for members to follow the rules, given all of the other variables in the model are held constant. This can have a larger effect over many hectares. In a study in Ethiopia, communities with smaller areas of restricted grazing showed higher levels of collective action for grazing land management, such as communities paying for a guard,

establishment of penalty systems, and reporting few violations (Gebremedhin *et al.,* 2004). The result here do not necessarily signify that the permitted grazing areas should be made smaller; size, composition, levels of dependence on the resource, prevailing norms, and types of technology employed to use the resource have an impact on the resource management because they affect the interaction of different actors around conservation (Agrawal & Gibson, 1999). However, multiple monitors may change this relationship and improve trust in members following the rules in communities that have larger grazing areas.

Frequency of Communication about Natural Resource Management

In a review of the social learning literature for natural resource management there was a general consensus that processes that support social learning involve sustained interaction between stakeholders with and ongoing deliberation and sharing of knowledge in a trusting environment (Cundill & Rodella, 2012). Thus here that sustained interaction in the form of communication frequency about natural resources management was included to see its possible influence on trust in members to follow the rules. When respondents were asked "How often do you communicate with other community members about resource management," 34.5% of respondents stated "ever few months," 26.3% of respondents stated "monthly," 21.1% stated "weekly," and 18.1% stated "daily". Respondents who selected monthly were less likely to have trust in members following the rules than the base of every few months with a p value of 0.0576 and an estimated coefficient of -0.9388. A one unit increase in the frequency of communication about natural resource management from 1 (every few months) to 2

(monthly) would expect to see a 0.9388 decrease in the log odds of being in a higher level of trust for members to follow the rules, given all of the other variables in the model are held constant. This is not significant at the 95% confidence level. Respondents who selected that they communicate weekly about natural resource management were less likely to trust members to follow the rules than respondents that communicated every few months, with a p value of 0.0047 and an estimated coefficient of -1.35. An increase in the frequency of communication about natural resource management from 1 (every few months) to 3 (weekly) would expect to see a 1.35 decrease in the log odds of being in a higher level of trust for members to follow the rules, given all of the other variables in the model are held constant. Respondents that selected that they communicate daily were also less likely to trust members to follow the rules when compared to respondents that communicated every few months with a p value of 0.0084 and an estimated coefficient of -1.39. An increase in the frequency of communication about natural resource management from 1 (every few months) to 2 (daily) would expect to see a 1.39 decrease in the log odds of being in a higher level of trust for members to follow the rules, given all of the other variables in the model are held constant. Communication is influencing others trust negatively. It was originally though that the relationship would be the inverse and that increased communication would serve as a rule enforcement strategy to improve trust. Communication frequency may be measuring the differences in communities in terms of local politics, strategic interactions, and the possibility of layered alliances. Agrawal & Gibson (1999) state that, "we often view community as a unified organic whole and this vision fails to attend

to these differences." While communicating every few months is perhaps better than weekly or daily communications this may not resolve the underlying problem of disagreements. There are two streams of thought regarding social learning in the literature. One focuses on the learning experienced and the types of outcomes that arise from attendance in participatory workshops and similar activities. Another focuses on learning in groups, networks, and associations that have framed social learning as a process that results in a change in resource management practices, or how things are done (Rodela, 2011). The negative result received here between trust in members to follow the rules and communication frequency could suggest that participatory workshops might be a better venue here. Further research is needed to understand what aspects of communication frequency caused reduced trust.

Rules Community Made

When respondents were asked, "Are management rules within the community created by members of this community," 92.3% of the respondents stated yes and 7.7% of the respondents said no. Respondents who selected that rules were made in the community were less likely to trust members to follow the rules, with a p value of 0.0153 and an estimated coefficient of -1.4655. A one unit increase in rules being community made from 0 (rules not community made) to 1 (rules are community made) would expect to see a 1.4655 decrease in the log odds of being in a higher level of trust for members to follow the rules, given all of the other variables in the model are held constant. Runge (1981) states that "even in small groups, the strategy of defection is still dominant without enforcement from outside." External checks and balances have been

promoted since the beginning of the literature in this field (Ostrom, 2000; Agrwal & Gibson, 1999). The question remains, however, to the degree of external enforcement that builds trust and the degree of external enforcement that undermines communal management. Further research regarding the types of external rules that build trust is needed to understand this relationship further.

Rule Breakers Punished

Graduated sanctions are an important part of Ostrom's (1990) and Wade's (1988 & 1994) signature work that define principles that can lead to successful communal management. However, the results received here suggest the contrary for the surveyed area. When respondents were asked if rule breakers were punished, 37% stated that rule breakers were not punished and 62.9% stated that they are punished. Respondents who stated that rule breakers were punished were less likely to trust members to follow the rules than other respondents, with a p value of 0.0444 and an estimated coefficient of -0.7278. A one unit increase in rule breakers punished from 0 (rule breakers are not punished) to 1 (rule breakers are punished) would expect a 0.7278 decrease in the log odds of being in a higher level of trust for members to follow the rules, given all of the other variables in the model are held constant. Justice and fairness perceptions regarding the punishment are likely to influence the response to punishment (Arvey & Jones, 1985; Ball *et al.*, 1993).

It is suspected that this result is picking up part of the unfair sentiments (62.4%) of restrictions for overharvesting. The fact that this unjust perception of natural resource rules and sanctions possibly makes respondents trust members less to follow the rules

begs a review of the harvesting rules in the park as they may be causing more resource degradation than conservation in communal lands. Sustainable harvest limits in communal lands with more communal say in natural resource regulations will be pertinent to restore trust in members following the rules. Rule enforcement alone will not resolve this problem and only make it worse. Further research into why punishments deteriorate trust is needed.

Summary

The majority of respondents had positive sentiments of trust for users to follow the rules. However, several significant relationships that potentially affect user's negative sentiments of distrust of users to follow the established rules were found. Respondents from the communities that are always managed transparently have less trust in members following the rules than other respondents. Thus, it is suggested that there be a slight limitation of transparency to build trust. Further research is needed to understand what aspects and degree of full transparency create distrust. Communities with larger permitted grazing areas have more distrust in members following the rules. It is suggested that multiple monitors be employed which would also assist in reducing overgrazing, particularly in large permitted grazing areas. Respondents who communicate more frequently with members about natural resource management have greater distrust in members following the rules. This reflects not only how others can influence our opinions but also the possibility of local alliances and divisions at play. Further research is needed to understand what aspects of communication frequency are causing reduced trust. Community members were found to have more trust in members

to follow the rules when rules were not community made. Further research regarding the types of external rules that build trust is needed to understand this relationship further. Punishment of rule breakers reduces respondents' trust in members to follow the rules. Since 62.4% of the respondents saw overharvesting rules other than pasture as unjust, natural resource rules in the park and in communities in the park need further review and community involvement in the formation of these rules. It is believed that the unjust perception of rules is why punishment reduced trust, because justice and fairness perceptions regarding the punishment are likely to influence the response to punishment (Ball *et al.*, 1993; Arvey & Jones, 1985) causing retaliation harvesting

CHAPTER V

CONCLUSION

This research was conducted to further inform policy and management strategies for sustainable land management amongst communal members that have boundaries in the *Cumbres de Monterrey* National Park. Household surveys were collected in communal lands that have boundaries within the *Cumbres de Monterrey* National Park to determine variables that influence park promoted conservation, sustainable land management, and institutional success. Using the survey data, logistical regression models were estimated to link the perceptions on park-promoted conservation, overgrazing, overharvesting, and trust in communal members to follow rules with institutional characteristics and other independent variables. One model was run to understand how effectively conservation is being promoted amongst communities by the park and what variables have contributed to conservation promotion. Two models were run to understand factors that affect overharvesting and overgrazing in these communities. Another model was run regarding rule following and how well community members trust others to follow the rules to see what variable promote institutional success. Backward conditional analysis was used to eliminate variables that did not hold a significant relationship using SAS statistical software. Many variables were eliminated, and suitable bases for developing the models were achieved. Many significant relationships were found, and based on these results several conclusions can be drawn. The main conclusions drawn for this research is that rules that are not just do not work, there is strong potential for locally funded payment for environmental services

to alleviate some of the injustice surrounding felling restrictions, and the park could improve their public relations amongst inhabitants.

5.1 Conclusions

5.1.1 Conservation, Resource Management, and Governance

Conservation Promotion

Trying to promote a locally funded payment for watershed recharge services project for inhabitants of the *Cumbres de Monterrey* park could improve conservation outcomes and perceptions in the park. Promoting conservation amongst rotational grazers may be more difficult and could use further research and inquiry. Communal lands could further promote conservation by clarifying boundaries amongst all communal members.

Overgrazing

To provide an offsetting deterrent for overgrazing in larger areas, multiple monitors and systematic livestock rotation could be helpful in reducing overgrazing. While compensation for labor schemes with few select participants did not work for park conservation promotion a change in the setup of a compensation scheme could have positive benefits to reduce overgrazing. Overharvesting resources were perceived to be unjust. It is suspect that the costs of not being able to cut any live trees was much greater than the minimal conservation compensation being allocated for few. Pasture regulation, on the other hand was perceived as just and external enforcement has been successful in reducing overgrazing. Voluntary compensations schemes with community involvement in the allocation of resources could allow for rotational grazing and fallow

periods through city water fees. In another study, poor farmers were the most willing to adjust their resource management for compensation (Swinton *et al.,* 2003). As the park is a water recharge zone and provides 70% of the water for the city of Monterrey (CONANP, 2013) and few grazers exist in the park, such a plan could result in tangible benefit for the city and the park. Other studies show that there is a willingness to pay in the area. External rule enforcement was effective when rules were perceived to be just and could result in retaliation harvesting when they are not. *Comunidades* were more likely to state that there is overgrazing and the more defined *ejido* structure with registered beneficiaries is possibly reducing grazing pressures. Many *comunidades* mentioned the desire to transition to an *ejido* structure through PROCEDE. The park may help expedite their application with PROCEDE to potentially reduce overgrazing in *comunidades.*

Overharvesting

Overharvesting rules and regulations were not perceived to be just and the presence of external sanctions was related to overharvesting. Rules and enforcement will not work when rules are perceived to be unjust. Communities with low population pressures and sustainable harvest rates have shown to have the same forest cover as strict protected areas without human settlement. SEMERNAT should reconsider sustainable harvest allocations within the park as revenge harvesting was already occurring, reducing conservation benefits. Particularly as illegal felling practices often optimize the healthiest trees reducing the long term health of the forest. The presence of microfinance groups was strongly related to overharvesting and increased monitoring in

these areas is needed. The absence of fences may have created a greater need to attend to animals and assure they are not damaging natural resources. Promoting fencing of animals for natural resource management does not appear to have any significant advantage for conservation. An increase in parcels sold to outside buyers has resulted in overharvesting and increased monitoring in these areas is needed. Depending on the title arrangement, external buyers may or may not be allowed access to communal grazing areas. Communities need to enforce community rules and clarify resource regulations with external buyers. The park needs to monitor areas with more external buyers more frequently than other areas.

Institutional Success

Communities that are always transparent have reduced levels of trust. Further research is needed to determine what aspects of complete transparency deter trust. Larger grazing areas are associated with decreasing levels of trust. Multiple monitors should be employed to increase trust in communities with larger grazing areas. If communities cannot afford multiple monitors, the park may need to assist in mobilizing resources for more monitors. There were decreasing levels of trust when rules were community made and a certain degree of external rules builds trust. However, the presence of punishment decreases levels of trust. It is questionable if internal or external sanctions are harsh or perceived as unjust. Revisiting overharvesting rules and their associated punishment in communities, with external actors is needed.

5.2 Implications

The results and conclusions from my study have several implications for policy and conservation as follows.

5.2.1 Conservation, Resource Management, and Governance

Conservation Promotion

Very clear pasture boundaries amongst all community members could improve conservation promotion. While the department of agrarian reform has publically available maps with boundaries only one male family member attends the *ejido* meetings. Assuring that boundaries are clear with all members could have positive conservation outcomes not only for communal lands within the park but throughout Mexico. Further research is need to understand why compensations schemes were reducing conservation practices and why rotational grazers have a negative disposition toward park conservation practices. Federal programs in Mexico are using payment for forest land owners in hydrological recharge zones to prevent owners from deforesting their land and are voluntary. There is federal motivation to have locally funded initiatives and areas that do not meet the federal priority criteria and have a willingness to pay are prime areas to pilot such a scheme. Other national parks in Mexico with communal land inhabitants could also potentially benefit from several actions suggested here:

- Assessing local willingness to pay for water recharge payment schemes that provide payment to forest owners.

- Assuring that communities clarify pasture boundaries amongst all communal members.
- Involving natural resource users that may have rich local conservation knowledge in focus group discussions and utilizing that information to influence conservation policy and management in the park.

Sustainable Management

External resource regulations that are perceived to be just and associated government punishment can improve conservation outcomes. Rules that are not just however only deteriorate conservation outcomes further. While many resource rules are made at a federal level, local perceptions need to be taken into account and flexibility on harvest schemes needs to be allowed with external enforcement to improve conservation outcomes. Recent studies have shown that forest communities with minimal population pressure and sustainable felling can provide equal conservation benefits as strictly protected parks without human settlement (Bray *et al.*, 2008). Multiple resource monitors for larger communal areas could reduce overgrazing. Further research is needed to inquire why this is occurring. Further research and inquiry is needed to determine how external buyers and the presence of microfinance are increasing the presence of overharvesting.

Institutional Success

Several institutional characteristics were associated with improved trust in members following the rules. Respondents with smaller grazing areas had greater trust compared to those with larger grazing areas. Respondents who communicated about

natural resource management every few months had greater levels of trust. When rules were not made by the community, respondents had greater trust in members following the rules. The absence of punishment was also associated with higher levels of trust. Research is needed to clarify and validate these relationships. Further research is also needed to understand when transparency starts to erode trust and when it further builds it. As there are different fairness perceptions regarding different resources further research is needed to understand what types of rules and punishment build and erode trust in members following the rules.

5.3 Limitations

This is only a case study that looked at the *comunidad* and *ejido* organizational structure. This study area had the greatest density of *communidades* in the state of Nuevo Leon (Departamento Agraria); however, there were only 7 communities included in this study. Further research with more *comunidades* could give greater insight into the institutional benefits and costs between *ejido* and *comunidades* organizational structures. A larger sample size and follow up surveys were unable to be conducted due to the escalating security concerns in the area. Due to the limited number of women respondents, significant differences in responses between genders could not be tested using the Man-Whitney test.

REFERENCES

Abakerli, S. (2001). A critique of development and conservation policies in environmentally sensitive regions in Brazil. *Geoforum*, **32**(4), 551-565.

Agrawal, A. (1999). *Greener Pastures: Politics, Markets and Community Among a Migrant Pastoral People.* Durham, NC: Duke University Press.

Agrawal, A. (2001). Common property institutions and sustainable governance of resources. *World Dev.,* **29**(10), 1649-1672.

Agrawal, A. (2002). Common resources and institutional sustainability. *The Drama of the Commons.* Washington, DC: That National Academies Press. 41-54.

Agrawal, A., & Gibson, C. C. (1999). Enchantment and disenchantment: the role of community in natural resource conservation. *World Dev.,* **27**(4), 629-649.

Agresti, A. (2007). *An Introduction to Categorical Data Analysis* Hoboken, NJ: Wiley-Interscience.

Ainslie, A. (1999). When 'community' is not enough: managing common property natural resources in rural South Africa. *Dev Southern Africa,* **16**(3), 375-401.

Allendorf, T. D., Smith, J. L., & Anderson, D. H. (2007). Residents' perceptions of Royal Bardia National Park, Nepal. *Landscape Urban Plan.,* **82**(1), 33-40.

Alexander, S. E. (2000). Resident attitudes towards conservation and black howler monkeys in Belize: the Community Baboon Sanctuary. *Environ. Conserv.,* **27**(4), 341-350.

Allet, M. (2012). Measuring the environmental performance of microfinance: a new tool. *Cost Manage.,* **26**(2), 6-17.

Anandajayasekeram, P., Davis, K., & Workneh, S. (2007). Farmer field schools: an alternative to existing extension systems? Experience from Eastern and Southern Africa. *J. Int. Agr. Extension Educ.,* **14**(1), 81-93.

Arvey, R. D., & Jones, A. P. (1985). The use of discipline in organizational settings: A framework for future research. *Res. Organ. Behav.,* **7**, 367-408.

Baland, J. M., & Platteau, J. P. (1996). *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?* Rome, Italy: Food and Agriculture Organization of the United Nations.

Balint, P. J. (2006). Improving community-based conservation near protected areas: the importance of development variables. *Environ. Manage.,* **38**(1), 137-148.

Ball, G. A., Trevino, L. K., & Sims Jr, H. P. (1993). Understanding subordinate reactions to punishment incidents: Perspectives from justice and social affect. *Leadership Quart.,* **3**(4), 307-333.

Barsimantov, J. A., Racelis, A. E., Barnes, G., & DiGiano, M. (2009). Tenure, tourism and timber in Quintana Roo, Mexico: Land tenure changes in forest ejidos after agrarian reforms. *Int. J. Commons.,* **4**(1), 293-318.

Bauer, H. (2003). Local perceptions of Waza National Park, northern Cameroon. *Environ. Conserv.,* **30**(2), 175-181.

Becerra, M., & Gupta, A. K. (2003). Perceived trustworthiness within the organization: The moderating impact of communication frequency on trustor and trustee effects. *Organ. Sci.,* **14**(1), 32-44.

Blaikie, P. (2006). Is small really beautiful? Community-based natural resource management in Malawi and Botswana. *World Dev.,* **34**(11), 1942-1957.

Bray, D. B., Duran, E., Ramos, V. H., Mas, J., Velazquez, A., McNab, R. B., Radachowsky, J. (2008). Tropical deforestation, community forests, and protected areas in the Maya Forest. *Ecol. Soc.,* **13**(2), 56.

Brechin, S. R., Wilshusen, P. R., Fortwangler, C. L., & West, P. C. (2002). Beyond the square wheel: toward a more comprehensive understanding of biodiversity conservation as social and political process. *Soc. Natur. Resour.*, **15**(1), 41-64.

Bruner, A. G., Gullison, R. E., Rice, R. E., & Da Fonseca, G. A. (2001). Effectiveness of parks in protecting tropical biodiversity. *Science*, **291**(5501), 125-128.

Campbell, D., & Berry, L. (1997). Breaking the cycle: Desertification and Migration on the US-Mexico Border. San Francisco, CA: Natural Heritage Institute.

Campbell, B., & Shackleton, S. (2001). The organizational structures for community-based natural resource management in Southern Africa. *Afr. Stud. Quart.*, **5**(3), 87-114.

Cernea, M. M., & Schmidt-Soltau, K. (2006). Poverty risks and national parks: Policy issues in conservation and resettlement. *World Dev.,* **34**(10), 1808-1830.

Chevalier, F. (1963). *Land and Society in Colonial México: the Great Hacienda*. Los Angeles, CA: University of California Press.

Child, B. (1996). The practice and principles of community-based wildlife management in Zimbabwe: the CAMPFIRE programme. *Biodivers. Conserv.,* **5**(3), 369-398.

Chowdhury, R. R. (2010). Differentiation and concordance in smallholder land use strategies in southern Mexico's conservation frontier. *P. Natl. Acad. Sci.,* **107**(13), 5780-5785.

Cleaver, F. (2002). Reinventing institutions: Bricolage and the social embededness of natural resource management. *Eur. J. Dev. Res.,* **14**(2), 11-30.

Cleaver, F. (2007). Understanding agency in collective action. *J. Hum. Dev.*, **8**(2), 223-244.

Cohen, M. (1998). Monitoring and enforcement of environmental policy. *Int Yearb Environ Resour. Econ.* **3**(44-106).

[CONABIO] Comisión Nacional Para el Conocimiento y Uso de la Biodiversidad. (2008). El Potosi-Cumbres de Monterrey. RTP-81. *CONABIO.* Retrieved September 24, 2009 from, http://www.conabio.gob.mx/conocimiento/regionalizacion/doctos/rtp_081.pdf.

[CONANP] Comisión Nacional de Áreas Naturales Protegidas. (2007). Programa de Manejo: Parque Nacional Cumbres de Monterrey. Retrieved September 24, 2009, from, http://www.conanp.gob.mx/anp/consulta/PCM-20DIC06.pdf

[CONANP] Comisión Nacional de Áreas Naturales Protegidas. (2013). Parque Nacional Cumbres de Monterrey. Retrieved December 5, 2013 from, http://cumbres_mty.conanp.gob.mx/

Conforti, V. A., & Cesar Cascelli de Azevedo, F. (2003). Local perceptions of jaguars and pumas in the Iguaçu National Park area, south Brazil. *Biol. Conserv.,* **111**(2), 215-221.

Coria, J., & Calfucura, E. (2012). Ecotourism and the development of indigenous communities: The good, the bad, and the ugly. *Ecol. Econ.,* **73**, 47-55.

Coronado-Quintana, JA. (2001). Range condition, tenure, management, and bio-physical relationships in Sonora, Mexico. *J. Range Manage.,* **54**(1), 31-38.

Cramb, R. (2006). The role of social capital in the promotion of conservation farming: the case of 'landcare' in the Southern Philippines. *Land Degrad. Dev.,* **17**(1), 23-30.

Cramb, R., & Culasero, Z. (2003). Landcare and livelihoods: the promotion and adoption of conservation farming systems in the Philippine uplands. *Int. J. Agr. Sustain.,* **1**(2), 141-154.

Cundill, G & Rodela, R. (2012). A review of assertations about the processes and outcomes of social learning in natural resource management. *J. Env. Mngt.* **113**. 7-14.

Deininger, K. W., & Minten, B. (1999). Poverty, policies, and deforestation: the case of Mexico. *Econ. Dev. Cult Change*, **47**(2), 313-344

Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., & Yesuf, M. (2009). Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environ. Change,* **19**(2), 248-255.

Dietz, T., Ostrom, E., & Stern, P. C. (2003). The struggle to govern the commons. *Science,* **302**(5652), 1907-1912.

Dillman, D. A. (2007). *Mail and Internet Surveys: The Tailored Design Method.* New York, NY: John Wiley & Sons.

Dobie, P. (2001). Poverty and the drylands. *Challenge Paper, The Global Drylands Initiative, UNDP Drylands Development Centre.* Nairobi,Kenya. Retrieved December 21, 2013 from http://www.undp.org/content/undp/en/home/librarypage/environment-energy/sustainable_land_management/challenge-paper-poverty-and-the-drylands.html

Doran, M., Low, A., & Kemp, R. (1979). Cattle as a store of wealth in Swaziland: implications for livestock development and overgrazing in Eastern and Southern Africa. *Am. J. Agr. Econ.,* **61**(1), 41-47.

Downs, A. (1962). The law of peak-hour expressway congestion. *Traffic. Quart.,* **16**(3).

Drijver, C. (1991). People's participation in environmental projects in developing countries. *Landscape Urban Plan.,* **20**(1), 129-139.

Duda, A. M. (2003). Integrated management of land and water resources based on a collective approach to fragmented international conventions. *Philos. T. Roy. Soc. B.,* **358**(1440), 2051-2062.

Dudley, N., Higgins-Zogib, L. H., Hockings, M., MacKinnon, K., Sandwith, T., & Solton, S. (2011). National parks with benefits: how protecting the planet's biodiversity also provides ecosystem services. *Solutions,* **2**(6), 87-95.

Ebert, A. (2010). *Promotion of indigenous vegetables in Asia: conservation and use of selected crops in Indonesia, the Philippines, and Taiwan*. Paper presented at the XXVIII International Horticultural Congress on Science and Horticulture for People

(IHC2010): III International Symposium, (397-403). Lisbon, Portugal: ISHS. Retrieved December 11, 2013 from http://www.actahort.org/books/918/918_51.htm

Ellis, E. A., & Porter-Bolland, L. (2008). Is community-based forest management more effective than protected areas?: A comparison of land use/land cover change in two neighboring study areas of the Central Yucatan Peninsula, Mexico. *Forest Ecol. Manag.*, **256**(11), 1971-1983.

Ellis-Jones, J. (1999). Poverty, land care, and sustainable livelihoods in hillside and mountain regions. *Mt. Res. Dev.,* **19**(3), 179-190.

Ezcurra, E., & Montaña, C. (1990). Los recursos naturales renovables en el norte árido de México. *Medio Ambiente y Desarrollo En México.* **1***,* 297-327.

Fabricius, C (2004). The fundamentals of community-based natural resource management. In C. Fabricius, E. Koch, H. Magome, & S. Turner (eds) *Rights, Resources and Rural Development: Community-Based Natural Resource Management in Southern Africa.* London, UK: Earthscan. 3-43.

Feder, G., Murgai, R., & Quizon, J. B. (2004). The acquisition and diffusion of knowledge: The case of pest management training in farmer field schools, Indonesia. *J. Agr. Econ.*, **55**(2), 221-243.

Feeny, D., Berkes, F., McCay, B. J., & Acheson, J. M. (1990). The tragedy of the commons: twenty-two years later. *Hum. Ecol.,* **18**(1), 1-19.

Fernandez-Gimenez, M. E. (2000). The role of Mongolian nomadic pastoralists' ecological knowledge in rangeland management. *Ecol. Appl.,* **10**(5), 1318-1326.

Fien, J., Scott, W., & Tilbury, D. (2001). Education and conservation: Lessons from an evaluation. *Environl. Educ. Res.*, **7**(4), 379-395.

Fowler, F. J. (2009). *Survey Research Methods, 4th Edition.* Thousand Oaks, CA. Sage.

Frauman, E., Banks, S. (2011). Gateway community resident perceptions of tourism development: Incorporating Importance-Performance Analysis into a Limits of Acceptable Change framework. *Tourism Manage.*, **32**(1), 128-140.

Fujisaka, S. (1993). A case of farmer adaptation and adoption of contour hedgerows for soil conservation. *Exp. Agr.,* **29**(01), 97-105.

Fukuyama, F. (2008). *Trust: Human Nature and the Reconstitution of Social Order.* New York, NY: Simon and Schuster.

Galletti, H. (1998). The Maya forest of Quintana Roo: thirteen years of conservation and community development. In R. Primack and D. Bray (ed) *Timber, Tourists, and Temples: Conservation and Development in the Maya Forest of Belize, Guatemala, and Mexico.* Washington, DC: Island Press. 427.

Gambetta, D. (Ed.) (1988). *Trust: Making and Breaking Cooperative Relations*. Oxford, England: Blackwell Publishers.

Gebremedhin, B., Pender, J., & Tesfay, G. (2004). Collective action for grazing land management in crop–livestock mixed systems in the highlands of northern Ethiopia. *Agr. Syst.,* **82**(3), 273-290.

Gerritsen, P. (1998). Community development, natural resource management and biodiversity conservation in the Sierra de Manantlán biosphere, Mexico. *Community Dev. J.,* **33**(4), 314-324.

Ghimire, K. B., & Pimbert, M. P. (Eds.) (1997). *Social Change and Conservation: Environmental Politics and Impacts of National Parks and Protected Areas*. London, UK: Earthscan.

Gibson, C. C. (1999). *Politicians and Poachers: The Political Economy of Wildlife Policy in Africa.* Cambridge, UK: Cambridge University Press. 160.

Gibson, C. C., Williams, J. T., & Ostrom, E. (2005). Local enforcement and better forests. *World Dev.,* **33**(2), 273-284.

Goldman, M. (2003). Partitioned nature, privileged knowledge: community-based conservation in Tanzania. *Dev. Change,* **34**(5), 833-862.

Goldsworthy, H. (2010). Microfinance, human security, and millennium development goal no. 7. *Perspect. Global Dev. Technol.,* **9**(3-4), 3-4.

Grimmelikhuijsen, S. G. (2012). Transparency and trust, An experimental study of online disclosure and trust in government. (Unpublished Doctoral Dissertation). Utrecht University, Utrecht, The Netherlands. Retrieved December 7, 2014 from http://dspace.library.uu.nl/handle/1874/218113

Hardin, G. (1968). The tragedy of the commons. *Science*, **162**(3859), 1243-1248.

Honey-Rosés, J. (2009). Illegal logging in common property forests. *Soc. Nat Resour.*, **22**(10), 916-930.

[ILC] International Land Coalition. (2007). Securing the Commons; Securing Property, Securing Livelihoods. *International Land Coalition.* Retrieved December 12, 2013, from http://www.landcoalition.org/global-initiatives/securing-commons.

Infield, M., & Namara, A. (2001). Community attitudes and behavior towards conservation: an assessment of a community conservation programme around Lake Mburo National Park, Uganda. *Oryx,* **35**(1), 48-60.

[IBM Corp.] International Business Machines Corporation. (2012). IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.

[IFAD] International Fund for Agricultural Development. (2004). Livestock Services and the Poor. *IFAD.* Retrieved December 27. 2003 from http://www.ifad.org/lrkm/book/english.pdf

[IUCN] International Union for the Conservation of Nature. (1980). *World Conservation Strategy: Living Resource Conservation for Sustainable Development. IUCN*. Retrieved October. 12. 2013 from https://portals.iucn.org/library/efiles/html/WCS-004/cover.html

[IUCN] International Union for the Conservation of Nature. (2013, September). IUCN Protected Areas Categories System. IUCN. Retrieved December 27, 2013 from **http://www.iucn.org/about/work/programmes/gpap_home/gpap_quality/gpap_pacategories/**

[INEGI] Instituto Nacional de Estadística y Geografía. (2005). Guía para la interpretación de cartografía: uso de suelo y vegetación. *INEGI.* Retrieved August 15, 2010 from http://www.inegi.org.mx/prod_serv/contenidos/espanol/bvinegi/productos/geografia/publicaciones/guias-carto/sueloyveg/1_250_III/Suelo_Vegeta.pdf

[INEGI] Instituto Nacional de Estadística y Geografía (2008). Resultados Preliminares del IX Censo Ejidal. *INEGI*. Retreived December 27. 2013. from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&cad=rja&ved=0CC8QFjAA&url=http%3A%2F%2Fwww.inegi.org.mx%2Finegi%2Fcontenidos%2Fespanol%2Fprensa%2Fboletines%2FBoletin%2FComunicados%2FEspeciales%2F2008%2FAbril%2Fcomunica3.doc&ei=-ojDUtSFJ4my2QXYoICIAQ&usg=AFQjCNHeVvj4oyHoIDH47gqJhDemFwlvFQ&sig2=QaUZI-d8G-E_3ul6ybe-vQ

[ITESM] Instituto Tecnológico y de Estudios Superiores de Monterrey (1994). Estudio de Cobertura, Uso Actual del Suelo y Creación de una Base de Datos sobre los Recursos Naturales para el Parque Nacional Cumbres de Monterrey. *ITESM, Centro de Calidad Ambiental. Laboratorio de Información Georreferenciada*. 213.

Ite, D. (1996). Community perceptions of the Cross River National Park, Nigeria. *Environ. Conserv.,* **23**(04), 351-357.

Jetti, A. (2011). *Microfinance, Gender and the Commons: Current Challenges and Future Possibilities*. University of Sydney: Sydney, Australia. Retrieved November 12, 2013 from http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/7318/1411.pdf?sequence=1

Johnson, K. A., & Nelson, K. C. (2004). Common property and conservation: The potential for effective communal forest management within a national park in Mexico. *Hum. Ecol.,* **32**(6), 703-733.

Kemf, E. (1993). *The Law of the Mother: Protecting Indigenous Peoples in Protected Areas*. San Francisco, CA.:Earthscan.

Klooster, D. (2000). Community forestry and tree theft in Mexico: resistance or complicity in conservation? *Dev. Change,* **31**(1), 281-305.

Kuehl, R. O., & Kuehl, R. (2000). *Design of Experiments: Statistical Principles of Research Design and Analysis.* Pacific Grove, CA: Duxbury/Thomson Learning

Lal, A., & Israel, E. (2006). An overview of microfinance and the environmental sustainability of smallholder agriculture. *Int. J. Agr. Res. Gov. and Ecol.,* **5**(4), 356-376.

Lambin, E. F., Turner, B. L., Geist, H. J., Agbola, S. B., Angelsen, A., Bruce, J. W., Folke, C. (2001). The causes of land-use and land-cover change: moving beyond the myths. *Global Environ. Change,* **11**(4), 261-269.

Leach, M., Mearns, R., & Scoones, I. (1999). Environmental entitlements: dynamics and institutions in community-based natural resource management. *World Dev.,* **27**(2), 225-247.

Lebel, L., Anderies, J.M., Campbell, B., Folke, C., Hatfield-Dodds, S., Hughes, T.P., Wilson, J. (2006). Governance and the capacity to manage resilience in regional social-ecological systems. *Ecol. Soc.* **11**(1): 19

Ley Agraria, Titulo Tercero, Capitulo V, Articulo 100. (1992). Congreso de Los Estados Unidos Mexicanos. Decreto. Retrieved November 29, 2013 from http://www.cem.itesm.mx/derecho/nlegislacion/federal/15/101.htm

Ley Agraria, Titulo Tercero, Capitulo V, Articulo 98. (1992). Congreso de Los Estados Unidos Mexicanos. Decreto. Retrieved November 29, 2013 from http://www.cem.itesm.mx/derecho/nlegislacion/federal/15/99.htM

Lindberg, K., Enriquez, J., & Sproule, K. (1996). Ecotourism questioned: Case studies from Belize. *Ann. Tourism Res.,* **23**(3), 543-562.

Li, W., & Liu, M. (2010). Several strategic thoughts on China's ecocompensation mechanism. *Resour Sci*, **5**(2).

Liverman, D. M. (1999). Vulnerability and adaptation to drought in Mexico. *Nat. Resour. J.,* **39** (99).

Lohr, S. L. (2010). *Sampling: Design and Analysis.* Boston, MA: Brooks Cole

Long, C., Li, H., Ouyang, Z., Yang, X., Li, Q., & Trangmar, B. (2003). Strategies for agrobiodiversity conservation and promotion: a case from Yunnan, China. *Biodivers. Conserv.,* **12**(6), 1145-1156.

López-Ramos, E. (1979). Geología de México. 3rd Edition. Mexico City, Mexico: Instituto De Geología, UNAM.

Luers, A. L., Naylor, R. L., & Matson, P. A. (2006). A case study of land reform and coastal land transformation in southern Sonora, Mexico. *Land Use Policy,* **23**(4), 436-447.

Machlis, G. E., & Tichnell, D. L. (1985). *The State of the World's Parks. An International Assessment for Resource Management, Policy, and Research*. Boulder, CO: Westview Press.

MacKinnon, J., & MacKinnon, K. (1986). *Review of the Protected Areas System in the Indo-Malayan Realm*. Gland, Switzerland: International Union for Conservation of Nature (IUCN).

Malik, S. (1998). Rural poverty and land degradation: a reality check for the Consultative Group on International Agricultural Research. UN FAO. Retrieved December 20, 2013 from http://www.fao.org/wairdocs/tac/x5784e/x5784e0d.htm

Manzano, M., Návar, J., Pando, M., & Martinez, A. (2000). Overgrazing and desertification in northern Mexico: highlights on north eastern region. *Annal. Arid Zone (India),* **39**(3), 285-304.

Marcus, R. R. (2001). Seeing the forest for the trees: integrated conservation and development projects and local perceptions of conservation in Madagascar. *Hum. Ecol.,* **29**(4), 381-397.

Matson, P., & Jewett, P. (2012). Ecosystems and Land-use Change in the Yaqui Valley: Does Agricultural Intensification "Spare Land for Nature"?. In P. Matson (ed) *Seeds of Sustainability.* Washington, D.C.: Island Press. 47-62.

McCabe, K. A., Rigdon, M. L., & Smith, V. L. (2003). Positive reciprocity and intentions in trust games. *J. Econ. Behav. Organ.,* **52**(2), 267-275.

McNeely, J. A. (1990). The future of national park. *Environ. Sci. Policy Sustain. Dev.,* **32**(1), 16-41.

Mehta, J. N., & Kellert, S. R. (1998). Local attitudes toward community-based conservation policy and programmes in Nepal: a case study in the Makalu-Barun Conservation Area. *Environ. Conserv.,* **25**(4), 320-333.

Moll, H. A. (2005). Costs and benefits of livestock systems and the role of market and nonmarket relationships. *Agr. Econ.,* **32**(2), 181-193.

Mugisha, A. R., & Jacobson, S. K. (2004). Threat reduction assessment of conventional and community-based conservation approaches to managing protected areas in Uganda. *Environ. Conserv.,* **31**(3), 233-241.

Muñoz-Piña, C., Guevara, A., Torres, J.M., Braña, J. (2008). Paying for the hydrological services of Mexico's forests: Analysis, negotiations and results. *Ecol. Econ.* **65**(4). 725-736

Natura, F. (1995). Local communities and protected areas: attitudes of rural residents towards conservation and Machalilla National Park, Ecuador. *Environ. Conserv.,* **22**(3).

Naughton-Treves, L., Holland, M. B., & Brandon, K. (2005). The role of protected areas in conserving biodiversity and sustaining local livelihoods. *Annu. Rev. Environ. Resour.,* **30**, 219-252.

Nelson, F., & Agrawal, A. (2008). Patronage or Participation? Community-based Natural Resource Management Reform in Sub-Saharan Africa. *Dev. Change,* **39**(4), 557-585.

Neyman, J. (1952). *Lectures and conferences on mathematical statistics and probability.* Seattle, WA: Washington Graduate School and US Department of Agriculture. 143.

Niamir-Fuller, M. (1998). The resilience of pastoral herding in Sahelian Africa. In F.Berkes, C. Folke, J. Colding (eds). *Linking Social and Ecological Systems:*

Management Practices and Social Mechanisms for Building Resilience. Cambridge, England: Cambridge University Press. 250-284.

Norman, S. M., Avolio, B. J., & Luthans, F. (2010). The impact of positivity and transparency on trust in leaders and their perceived effectiveness. *Leadership Quart.,* **21**(3), 350-364.

O'Brien, R. M. (2007). A caution regarding rules of thumb for variance inflation factors. *Qual. Quant*, **41**(5), 673-690.

Ojeda-Revah, L., Bocco, G., Ezcurra, E., Espejel, I., 2008. Land-cover/use transitions in the binational Tijuana River Watershed during a period of rapid industrialization. *Appl. Veg. Sci.* **11**(1), 107–116.

Ormsby, A., & Kaplin, B. A. (2005). A framework for understanding community resident perceptions of Masoala National Park, Madagascar. *Environ. Conserv.,* **32**(02), 156-164.

Ortega-Huerta, M. A., Kral, K. K. (2007). Relating biodiversity and landscape spatial patterning to land ownership regimes in northeastern Mexico. *Ecol. Soc.,* **12**(2), 12.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge, England: Cambridge University Press.

Ostrom, E. (1994). *Neither market nor state: Governance of Common-Pool Resources in the Twenty-First Century.* Washington, DC.: International Food Policy Research Institute.

Ostrom, E. (2000). Collective action and the evolution of social norms. *J. Econ. Persp.* 137-158.

Ostrom, E., & Nagendra, H. (2006). Insights on linking forests, trees, and people from the air, on the ground, and in the laboratory. *P. Natl. Acad. Sci.*, **103**(51), 19224-19231.

Perez-Verdin, G., Kim, Y. S., Hospodarsky, D., & Tecle, A. (2009). Factors driving deforestation in common-pool resources in northern Mexico. *J. Environ. Manage.*, **90**(1), 331-340.

Pesek, T., Abramiuk, M., Fini, N., Rojas, M. O., Collins, S., Cal, V., Arnason, J (2010). Q'eqchi'Maya healers' traditional knowledge in prioritizing conservation of medicinal plants: culturally relative conservation in sustaining traditional holistic health promotion. *Biodivers. Conserv.,* **19**(1), 1-20.

Porter-Bolland, L., Ellis, E. A., Guariguata, M. R., Ruiz-Mallén, I., Negrete-Yankelevich, S., & Reyes-García, V. (2012). Community managed forests and forest protected areas: An assessment of their conservation effectiveness across the tropics. *Forest Ecol. Manag*., **268**, 6-17.

Poteete, A. R., & Ostrom, E. (2004). In pursuit of comparable concepts and data about collective action. *Agr. Syst.,* **82**(3), 215-232.

Pretty, J., & Smith, D. (2004). Social capital in biodiversity conservation and management. *Conserv. Biol.,* **18**(3), 631-638.

Pretty, J., & Ward, H. (2001). Social capital and the environment. *World Dev.,* **29**(2), 209-227.

Raval, S. R. (1994). Wheel of life: perceptions and concerns of the resident peoples for Gir National Park in India. *Soc. Natur. Resour.*, **7**(4), 305-320.

Rawlins, B. (2006). Measuring the relationship between organizational transparency and trust. Paper presented at the *10th International Public Relations Research Conference: Roles and Scopes of Public Relations.* Miami, FL: 425. Retrieved December 3, 2013 from http://www.docunator.com/bigdata/1/1366449053_93ee43dea2/iprrc_10_proceedings.pdf#page=425

Reardon, T., & Vosti, S. A. (1995). Links between rural poverty and the environment in developing countries: asset categories and investment poverty. *World Dev.,* **23**(9), 1495-1506.

Ripl, W. (2003). Water: the bloodstream of the biosphere. *Philos T Royal Soc B,* **358**(1440), 1921-1934.

Rippey, P. (2012). Microfinance and climate change: threats and opportunities. In *Greening the Financial Sector*. Berlin, Heidelberg: Springer. 215-239.

Robinson, L. W., & Berkes, F. (2011). Multi-level participation for building adaptive capacity: Formal agency-community interactions in northern Kenya. *Global Environ. Chang.* **21**(4), 1185-1194.

Rodela, R. (2011). Social Learning and Natural Resource Management: The Emergence of Three Research Perspectives. *Ecol. Soc.* **16**(4). 30

Rola, A. C., Jamias, S. B., & Quizon, J. B. (2002). Do farmer field school graduates retain and share what they learn? An investigation in Iloilo, Philippines. *J. Int. Agr. Ext. Educ.*, **9**(1), 65-76.

Runge, C. F. (1981). Common property externalities: isolation, assurance, and resource depletion in a traditional grazing context. *Am J Agr Econ,* **63**(4), 595-606.

Schmidt-Soltau, K., & Brockington, D. (2007). Protected areas and resettlement: What scope for voluntary relocation? *World Dev.,* **35**(12), 2182-2202.

Saldivar, A., Oliver, M. & Isidro, A. (2013). Valoración y demanda del servicio ambiental hidrológico en el parque nacional Cumbres de Monterrey. *Revisa Natura@economía*, **1**(2), 9-28.

Sánchez-Azofeifa, G. A., Quesada, M., Cuevas-Reyes, P., Castillo, A., & Sánchez-Montoya, G. (2009). Land cover and conservation in the area of influence of the Chamela-Cuixmala Biosphere Reserve, Mexico. *Forest Ecol Manag*, **258**(6), 907-912.

Sanderson, S. R. W. (1984). *Land Reform in Mexico, 1910-1980*. Academic Press, Inc. New York, NY.

Sas Institute. (2011). *SAS/STAT 9.3 user's guide*. SAS Institute. Retrieved October 20, 2013 from https://support.sas.com/documentation/cdl/en/statug/63962/HTML/default/viewer.htm#titlepage.htm

[SEMERNAT] Secretaria de Medio Ambiente y Recursos Naturales. (2003). Documentos sobre desertificación cambio de uso de suelo y deforestación. Tlalpan, Mexico: SEMERNAT.

[SEMERNAT] Secretaria de Medio Ambiente y Recursos Naturales, Dirreción de Geomática. (2004). Degradación del suelo en la República Mexicana – Escala 1:250000. Dirección de Geomática. Mexico http://www.conabio.gob.mx/informacion/gis/layouts/degra250kgw.png

[SEMERNAT] Secretaria de Medio Ambiente y Recursos Naturales. (2009). Estudio Sobre el Cambio de Uso de Suelo en el Parque Nacional Cumbres de Monterrey, Periodo 1976 – 2008. Monterrey, NL: Comisión Nacional de Areas Naturales Protegidas, Región Noreste y Sierra Madre Oriental.

Selebatso, M., Moe, S. R., & Swenson, J. E. (2008). Do farmers support cheetah Acinonyx jubatus conservation in Botswana despite livestock depredation? *Oryx,* **42**(3), 430.

Sias, P.M., & Jablin, F. M. (1995). Differential superior-subordinate relations, perceptions of fairness, and coworker communication. *Human Comm. Res.*, **22**(1), 5-38.

Smeed, R. J. (1968). Traffic studies and urban congestion. *J Transp Econ Policy*, 33-70.

Staatz, J.M. (1987). The Structural Characteristics of Farmer Cooperatives and Their Behavioral Consequences. Washington, DC: USDA Agricultural Cooperative Services. Retrieved December 15, 2013 from http://www.rurdev.usda.gov/rbs/pub/sr18/strcture.pdf

Stave, J., Oba, G., Nordal, I., & Stenseth, N. C. (2007). Traditional ecological knowledge of a riverine forest in Turkana, Kenya: implications for research and management. *Biodivers. Conserv.,* **16**(5), 1471-1489

Swinton, S. M., Escobar, G., & Reardon, T. (2003). Poverty and environment in Latin America: concepts, evidence and policy implications. *World Dev.,* **31**(11), 1865-1872.

Thomson, J. M. (1967). An evaluation of two proposals for traffic restraint in Central London. *J R Stat Soc Ser A-G*. 327-377.

Tisdell, C. A. (1995). *Investment in Ecotourism: Assessing its Economics.* School of Economics series in Biodiversity Conservation: Studies in its Economics and Management (No. 145217). Queensland, Australia: University of Queensland. Retrieved November 20, 2013 from http://ideas.repec.org/p/ags/uqsebd/145217.html

Todd, S. W., & Hoffman, M. T. (1999). A fence-line contrast reveals effects of heavy grazing on plant diversity and community composition in Namaqualand, South Africa. *Plant Ecol.*, **142**(1-2), 169-178

Trakolis, D. (2001). Local people's perceptions of planning and management issues in Prespes Lakes National Park, Greece. *J Environ. Manage.,* **61**(3), 227-241.

Transparency International (2013). Corruption by Country /Territory. *Transparency International.* Retrieved December 26. 2013 from **http://www.transparency.org/country#MEX**

Trochim, W. M., & Donnelly, J. P. (2007). *Research Methods Knowledge Base, 3rd Edition.* Mason, OH: Atomic Dog.

Uphoff, N. (1993). Grassroots organizations and NGOs in rural development: Opportunities with diminishing states and expanding markets. *World Dev.,* **21**(4), 607-622.

Upreti, B. R. (2002). *Management of Social and Natural Resource Conflict in Nepal.* Saarbrücken, Germany: LAP LAMBERT Academic Publishing.

Velázquez, A. (2012). Review of Revolutionary Parks. Conservation, Social Justice, and Mexico's National Parks, 1910-1940. *Stud. Soc. Justice, 7*(1), 169-171.

Vollan, B. (2008). Socio-ecological explanations for crowding-out effects from economic field experiments in southern Africa. *Ecol. Econ.,* **67**(4), 560-573.

Wade, R. (1998 & 1994). *Village Republics: Economic Conditions for Collective Action in South India.* San Francisco, CA: ICS Press.

Walpole, M. J., & Goodwin, H. J. (2001). Local attitudes towards conservation and tourism around Komodo National Park, Indonesia. *Environ. Conserv.,* **28**(2), 160-166.

West, P. C., & Brechin, S. R. (1991). *Resident Peoples and National Parks: Social Dilemmas and Strategies in International Conservation*. Tucson, AZ: University of Arizona Press.

Wiggins S, Keilbach N, Preibisch K, et al. (2002). Discussion – Agricultural policy reform and rural livelihoods in central Mexico. *J Dev.Stud*. **38** (4), 179–202.

Williams, D. M. (1996). Grassland enclosures: catalyst of land degradation in Inner Mongolia. *Human. Organ.*, **55**(3), 307-313.

Wilson, P. N., & Thompson, G. D. (1993). Common Property and Uncertainty: Compensating Coalitions by Mexico's Pastoral" Ejidatarios". *Econ. Dev. Cult. Change,* **41**(2), 299-318.

Wittemyer, G., Elsen, P., Bean, W. T., Burton, A. C. O., & Brashares, J. S. (2008). Accelerated human population growth at protected area edges. *Science,* **321**(5885), 123-126.

Woolcock, M. (1998). Social capital and economic development: Toward a theoretical synthesis and policy framework. *Theor. Soc.,* **27**(2), 151-208.

Wunder, S., Campbell, B., Frost, P. G., Sayer, J. A., Iwan, R., & Wollenberg, L. (2008). When donors get cold feet: the community conservation concession in Setulang (Kalimantan, Indonesia) that never happened. *Ecol Soc,* **13**(1), 12.

Yasmi, Y., Colfer, C., Yuliani, L., Indriatmoko, Y., & Heri, V. (2007). Conflict management approaches under unclear boundaries of the commons: experiences from Danau Sentarum National Park, Indonesia. *Int. Forest. Rev.,* **9**(2), 597-609.

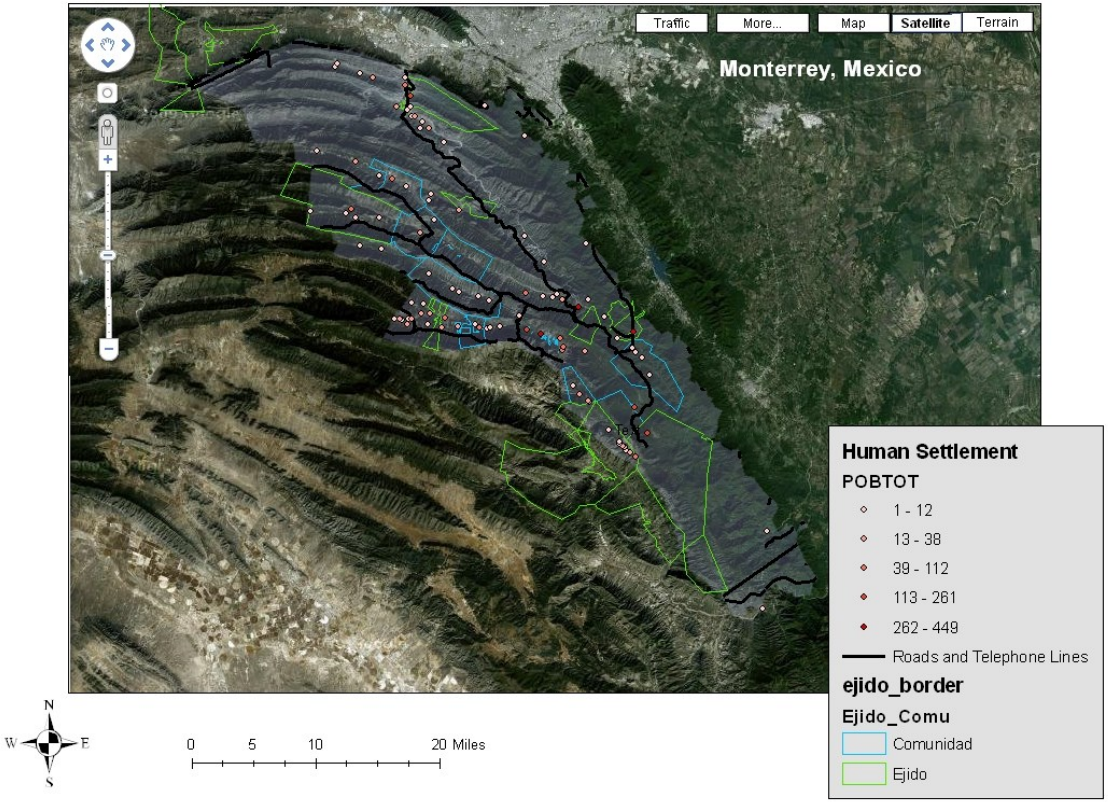
Zar, J. H. 1984. Biostatistical Analysis. Englewood Cliffs, NJ: Prentice-Hall

APPENDIX A

Author	Wade	Ostrom	Baland and Platteau
	Facilitating Conditions	Design Principles	Conclusions presented as faciliatating successful governance of the Commons
Resource system Characterisitcs	Small Size Well Defined Boundaries	Well-defined boundaries	NONE presented as important
Group Characteristics	Small Size Clearly Defined Boundaries Past Successful Experiences- social Capital Interdependence among group members	Clearly defined boundaries	Small size Shared Norms Past successful experiences-social capital Appropriate leadership-young, familiar with changing external environments, connected to local traditional elite Interdependence among group members Heterogeniety of endowments, homogeniety of identities and interests
Relationship between resource system characteristics and group characteristics	Overlap between user group residential location and resource location High levels of dependence by group members on resource location	NONE presentes as Important	Overlap between user group residential lcoation and resource location Fairness in allocation of benefits from common resources
Institutional Arrangements	Locally devised access and management rules Ease in enforcement of rules Graduated Sanctions	Locally devised access and management rules Ease in enforcement of rules Graduated sanctions Availability of low-cost adjudication	Rules ares imple and easy to understand Locally devised access and management rules Ease in enforcement of rules Accountability of monitors and other officials to users
Relationship between resource system and institutional Arranagements	Match restrictions on harvests to regeneration of resources	Match Restrictions on harvest to regeneration of resources	NONE presented as important
External Environment	Technology: Low-Cost exclusion Technology State: Central Goverments should not undermine lcoal authority	Technology: NONE Presentesas important State: Central Governments should not undersmine local authority Nested levels of appropriation, provision, enforcement, governance	Technology: NONE presented as important State: Supportive external sanctioning institutions Appropriate levels of external aid to compensate lcoal users ofr conservation activities.

Concepts were summarized and organized from Baland and Platteau (1996), Wade (1988 & 1994), and Ostrom (1990)

Communities in "Cumbres de Monterrey" National Park



APPENDIX C

Locality Code_____
Date_____
Survey #_____

Are you male or female?	Yes___ No___ (will not be asked, but rather recorded)
Are you a member of a communal land or ejido?	Yes____ No_____
Do you graze animals in the communal area?	Yes___ No___
How many hectares of this community are grazed?	_____ha
How many hectares are you allowed to graze?	_____ha
Are animals herded individually or in a group with multiple owners?	Individually_____ Multiple Owners_____ Both_____
How clear are the boundaries in which members are allowed to graze?	Not clear_____ Slightly clear_____ Clear_____ Very clear_____
Is hay cut and dried/stored?	Yes__ No___ If yes, how many times per year?____
How predictable is the year's harvest?	Not predictable_____ Predictable_____ Slightly predictable____Very Predictable____
In the case of increased forage growth is land rented out to external livestock owners?	Yes___No____
In the case of drought are members forced to sell livestock by the community government?	Yes__No___ If yes is this performed in a fair manner? Yes___ No___
Are any of the resources in the community pooled together for sale?	Yes___ No___ If Yes, please state which resources._____ _____ _____
How many people are part of this community?	_____people Total women_____ Total men_____
How many households actively graze animals in this community?	____people
Are there any groups or organizations that exist within this community?	Yes____ No____ If yes how many? _____ How old is the longest functioning organization?_____yrs

Locality Code_____
Date_____
Survey #_____

Have any of these organizations been successful in marketing products or providing benefits at a discounted rate?	Yes_____ No_____
Do community leaders generally have previous experience in leadership?	Yes_____ No_____
How often do members of the community meet?	_____per year
Generally how many members usually attend meetings?	0– 25% 25%-50% 50%-75% 75%-100%
Is your opinion influential in the community decision making process?	Never Sometimes Usually Always
Is the community managed in a transparent way?	Never Sometimes Usually Always
Are community rules and regulations fair for all members of the community?	Never Sometimes Usually Always
In your community, what role do women play in forming rules and regulations?	None Occasional Input Same input as Men More input than men
Is there a term limit for community presidents?	Yes_____ No_____ If Yes, who many years are presidents able to stay in power? _____ Yrs
How often do community members rely on each other for help?	Never A Few times a Year A Few times a month A Few times a week
Are there any groups that participate in microfinance in the community?	Yes_____ No_____
Please select which earnings category fits the monthly average total income earned for you and your family:	500 - 775 775 -2,500 2,500 - 4,500 4,500-7,000 7,000-9,500 9,500-12,000 12,000-16,000 16,000-21,000 21,000-30,000 30,000-mas
How many people are in your family?	Adults (18 or older)_____ Children(17 or younger)_____

Locality Code_____
Date_____
Survey #_____

Are there restrictions on usage of any other natural resource?	Yes_____ No_____ If yes, do these restrictions help regenerate the natural resource? Yes_____ No_____ Please state the natural resource_____
Are fences used to exclude grazing from different livestock owners?	Yes_____ No_____
Are there natural boundaries (such as streams) that are used to exclude grazing from different livestock owners?	Yes_____ No_____
Does this community practice rotational grazing?	Yes_____ No_____ If yes, when did they start this practice _____ yrs ago
How many wells does this community have?	_____ Please state the year in which each well was established_____
How many stables does this community have?	_____ Please state the year in which each stable was established_____
When were the most recent fence boundaries created?	_____ yrs/months ago
Has your sale of livestock numbers increased or decreased over 10 years?	Decreased_____ Staid the same_____ Increased_____
Is the type of animals that you sold 10 years ago different than the type of animals that you sell now?	Yes_____ No_____ If yes please explain_____
Do other governmental authorities respect the decisions of local authorities?	Yes_____ No_____
Do other governmental authorities and institutions support local punishments for rule breakers?	Yes_____ No_____ Not involved_____
Do other governmental or park authorities sanction bad natural resource management or rule breaking?	Yes_____ No_____ If yes, please state what agency they are with and what the sanction is? ____ _____ _____
Do community members receive compensation for conservation activities?	Yes_____ No_____ If yes, state who gives the compensation _____ _____

Locality Code_____
Date_____
Survey #_____

Is any member of your family enrolled in a government program that assists you financially in any way?	Yes_____ No_____ If yes, please list programs._____ _____
How many years of school did you attend?	_____years
What percentage of your income is derived from agricultural products from the community?	25% 50% 75% 100%
Is pasture usage regulated in a fair manner for all members?	Yes_____ No_____
Are other agricultural harvesting besides range management regulated in a fair manner for all members?	Yes_____ No_____
Do you think that pasture is overstocked with animals or over grazed by community members?	Yes_____ No_____
Do you think that other resources are over harvested or that the demand is too high?	Yes_____ No_____ If yes please state which._____
Does the level of demand of pasture changing gradually?	No_____ Gradually Increasing _____ Gradually Decreasing _____
Are rules within the community simple and easy to understand?	Yes_____ No_____
Are management rules within the community created by members of this community?	Yes_____ No_____ If yes, do those members currently use natural resources in the community? Yes_____ No_____
Are management rules easy to enforce? Yes___ No___	Yes_____ No_____
Are rule breakers punished?	Yes_____ No_____ If yes, how are they punished by and what is the punishment?_____ _____ Is the punishment easy to enforce? Yes_____ No_____ Do the people that monitor the resources use do their jobs responsibly? Yes_____ No_____ N/A _____
Are there restrictions on harvest for pasture? If yes, do these restrictions help regenerate pasture?	Yes_____ No_____ If yes, do these restrictions help regenerate pasture? Yes_____ No_____

Locality Code_____
Date_____
Survey #_____

How well do you trust other community members to follow the established rules?	Never Sometimes Usually Always
How often do you communicate with other community members about resource management?	Daily Weekly Monthly Every few months
If you are member of an EJIDO, how many parcels have been sold to people outside the community?	_____ N/A _____
Please state how many animals you currently have	Cows _____ Calves _____ Sheep_____ Lamb _____ Goat_____ Kids _____
Do you think that your community is performing better than other communities? Why?	Yes_____ No_____ Why? _____ _____ _____ _____ _____
What conservation practices does your community currently used or what have they used in the past?	_____ _____ _____ _____ _____

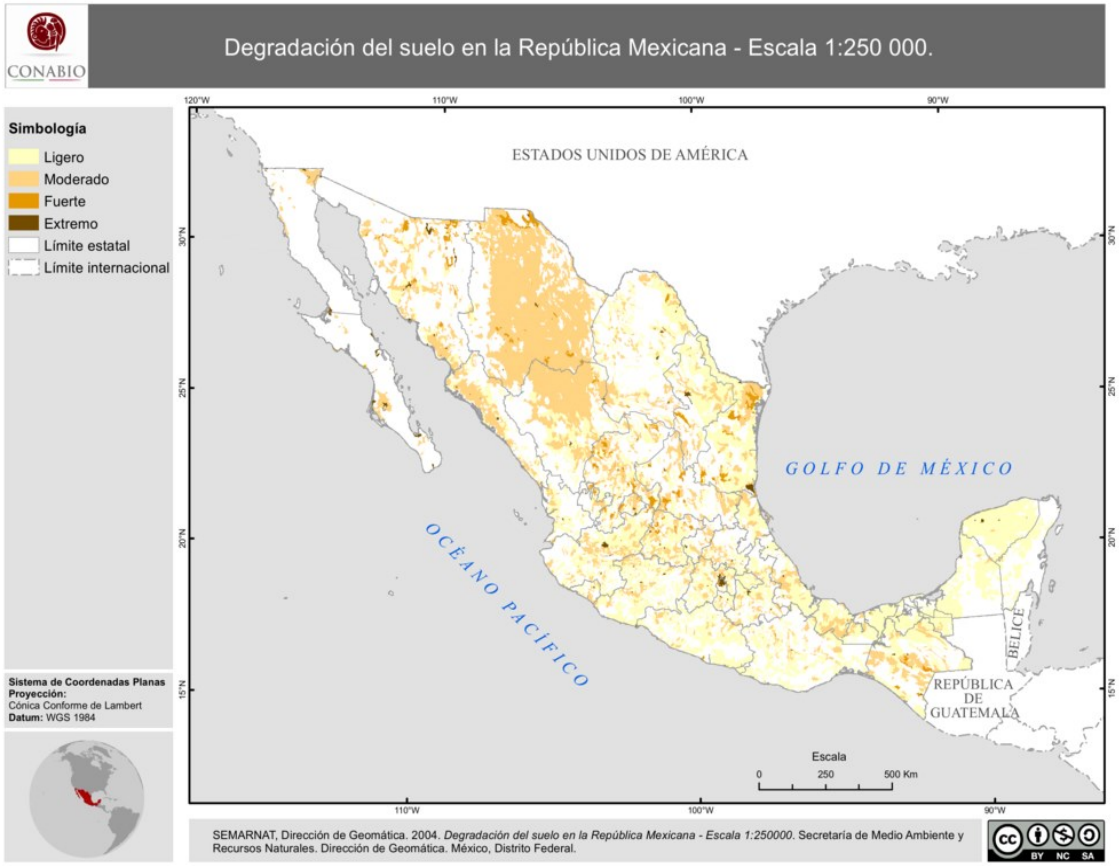
ONLY FOR COMMUNITIES INSIDE AND ADJACENT TO THE PARK:

How has the establishment of the park affected your natural resource management practices?	Toward more conservation No impact Toward less conservation
How has the establishment of the park affected your overall wellbeing?	Better off No impact Worse off

Two questions were added on to the end of the survey:

1. **Has anyone come to your community to offer a training? If so, whom, and how frequently do they come?**
2. **How are decisions made in our household?**
   100%-Man 75%-Man 50/50 75%-Woman 100%-Woman

APPENDIX D



(SEMERNAT, 2004)